MINERALS OF CALIFORNIA

BULLETIN No. 91

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FLETCHER HAMILTON State Mineralogist

San Francisco] BULLETIN No. 91 [November, 1922

Minerals of California

COMPLIMENTS OF
Boyd L. Root,
STATE MINERALOGIST

BY

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SACRAMENTO, 1923

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LETTER OF TRANSMITTAL.

November 1, 1922.

To His Excellency, the Hon. Wm. D. Stephens,
Governor of the State of California,
Sacramento, California.

Sir:

I have the honor to transmit herewith Bulletin 91 of the State Mining Bureau upon the minerals of California.

This bulletin records our knowledge of California minerals to date, and is a revision of a similar bulletin, No. 67, issued in 1914. The edition of Bulletin No. 67 was soon exhausted, and there has been a continual demand for this work.

The author, Arthur S. Eakle, Ph. D., Professor of Mineralogy, of the University of California, has performed a particular service in cooperating with the State Mining Bureau in making possible this addition to our records.

Respectfully submitted.

Fletcher Hamilton,
State Mineralogist.

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INTRODUCTION.

The first list of California minerals was published by W. P. Blake in 1866, and it comprised about seventy-five mineral species. At that early time California was a new and largely unexplored field, and only a few scattered localities were known for mineral specimens; consequently, the list was short and not at all representative.

The second list appeared in 1884 as a part of the Fourth Annual Report of the State Mining Bureau, by Henry G. Hanks, who was then State Mineralogist. This list included double the number of previously known minerals, and gave detailed descriptions of some of the localities, and much instructive matter relating to minerals of economic value.

The third list was issued in 1914 as Bulletin 67 of the California State Mining Bureau. In the thirty years which elapsed since the appearance of the second list, our knowledge of the geology and mineralogy of the State became vastly increased. The ore deposits of many of the counties, the gem and borate deposits of the southern counties, and the petrography of many districts, had been investigated and described, so that the third list contained more than double the number of definite mineral species given by Hanks, besides many subspecies and varieties.

This fourth list is an enlarged edition of the third list. Many additional species are included and the localities in which some of the more common economic minerals occur, have been greatly multiplied. The desire has been to make the list as complete as possible of the known minerals, and where they occur, but the list of localities where the same mineral might be found is necessarily incomplete. Many minerals are so commonly distributed throughout the State, in small bodies or pockets of metallic minerals and as rock-forming minerals, that it would be impossible to cite all of their occurrences. In such a vast area as California, localities may be known to local collectors where excellent specimens may occur, unknown to the author, and they could materially assist in the preparation of a future and more comprehensive list, if they would kindly notify the author of such occurrences. Some mineral species may be known to occur in the State which have not been mentioned in this work, but it is believed that they will be very few in number.

So many minerals and localities are included in the list, that geological and petrographical descriptions in detail, have had to be omitted, and reference must be made to the bibliography at the end of the work

under the author's name and number. This bibliography includes, with few exceptions, only those articles which bear directly on the minerals of the State, omitting the great amount of literature of a general nature on the geology and mining industry of the State.

The various kinds of minerals have been grouped under a chemical classification in order to be more instructive and show better the relations of the various species and varieties. The crystal forms have been cited and the chemical analysis given, to show what has been done in these two lines of work on California minerals.

In addition, the indices of refraction and the characteristic blowpipe and chemical tests for the minerals are given in order to make the list more useful in the detection of the minerals.

The author is indebted to Edgar Woodcock, formerly of the State Mining Bureau, Walter W. Bradley of the State Mining Bureau, M. Vonsen of Petaluma, John Melhase of the Southern Pacific Railroad, W. F. Foshag of the U. S. National Museum, and Gordon Surr of Porterville, for much useful data concerning mineral localities. The excellent bulletin by Dr. Larsen on the "Microscopic Determination of the Non-opaque Minerals" has been used for the optical data.

New minerals and important localities for known minerals are constantly being discovered as California becomes more settled and prospected, and this list must be considered more as a check-list to form a basis for continual additions.

CHAPTER I.

NATIVE ELEMENTS.

Non-metals.	*Metals.*	
Diamond.	Gold.	Platinum.
Graphite.	Gold amalgam.	Iridium.
Sulphur.	Bismuth gold.	Platiniridium.
	Electrum.	Palladium.
	Silver.	Iridosmine.
Semi-metals.	Copper.	Osmium.
Antimony.	Mercury.	Rhodium.
Arsenic.	Lead.	Ruthenium.
Bismuth.	Tin.	Iron.
Tellurium.	Zinc.	Awaruite.

NON-METALS.

1. DIAMOND.

Native carbon, C.

Isometric. Octahedrons and hexoctahedrons common. Crystal faces often curved. Perfect octahedral cleavage. Brittle. Yellow and colorless crystals common. Red, orange, green, blue, brown and black are rarer shades. H = 10; G = 3.5.

Refractive index: $n = 2.419$.

Infusible and not acted on by acids.

The extreme hardness and brilliant adamantine luster serve to distinguish diamond from quartz and other glassy minerals.

Bort is a hard rounded form without distinct cleavage, unsuitable for gems.
Carbonado is a hard black variety without cleavage.

Diamonds were found in California soon after placer mining began. As early as 1849, Lyman[3] reported seeing a pale yellow crystal about the size of a small pea, which came from one of the placers. A few years later they were observed in the gold gravels at Cherokee, Butte County, and this locality became the most noted one in the State for the number found.

Placer deposits elsewhere have also yielded them from time to time, so their occurrence has not been limited to any one field. No record has been kept of the total number found, but it is probably between four and five hundred. Since all of them have been chance finds, there can be no doubt that many more have been overlooked or destroyed. A few of the stones found are over two carats in weight and of good quality, but the majority are small and mostly "off color," usually with a pale yellow tinge. Most of these diamonds now in the possession of different individuals were found during the days when placer mining and hydraulicking were at their height, and since that time diamond finds have been rare.

The mode of origin and sources of the diamond are as yet unknown. They have only been found in placer gravels and in "black sands" and concentrates of placer mines. Presumably their origin has been in the basic igneous rocks from which the serpentines of the gold regions have been derived, and continued search may yet reveal them *in situ*. The discovery near Oroville of an apparent pipe of serpentinized rock bearing a resemblance to the diamond pipes of South Africa has led to some active operations on the part of the United States Diamond Mining Company, and a shaft has been sunk, which has not proved successful. The rock is a hard eclogite differing in its character from the kimberlite of South Africa. Hanks[6] gives an interesting account of the diamonds found during the early days of gold mining, and Turner[6] and Storms[3] contribute short articles on California diamonds.

Amador County: A few small stones have been picked up near the towns of Volcano, Oleta and Fiddletown.

Butte County: In 1853 it was observed that diamonds occurred in the gravels at Cherokee Flat, about nine miles north of Oroville. More than three hundred good diamonds have been obtained from the placers in this district and it leads all other districts in the State. It seems quite probable that the source of these diamonds is not far from this vicinity. Silliman[7][8] gave the contents of the black sands at Cherokee as platinum, iridium, iridosmine, gold, pyrite, chromite, magnetite, limonite, diamonds, quartz, rutile, almandite garnet, topaz, zircon and epidote. Some have also been found in the placers at Thompson Flat, two miles north of Oroville.

El Dorado County: A diamond weighing 1¼ carats was found at Forest Hill. About sixty have been found near Placerville, namely, on Webber Creek, in White Rock canyon and at Smith's Flat.

Fresno County: Small diamonds are reported to have been found a few miles north of Coalinga.

Imperial County: Some small diamonds are said to have been found near the San Diego border.

Nevada County: A 1½ carat stone was found at French Corral.

Siskiyou County: Diamonds occur in the placer gravels at Hamburg Bar.

Trinity County: Microscopic examinations of the black sands of Trinity River and some of its tributaries have shown the presence of small diamonds as a constituent of these sands.

2. GRAPHITE—Plumbago—Black Lead.

Native carbon, C.

Hexagonal, rhombohedral. Commonly in scaly or foliated masses. Color dark steel-gray to dull black. Perfect basal cleavage. Soft with greasy feel. H=1—2; G=2.2.

Insoluble in acids and unaffected by heating. When mixed with potassium nitrate and sulphur and heated on platinum foil, the mixture will deflagrate. Molybdenite, which closely resembles it, is fusible and soluble.

Graphite is a common constituent of crystalline limestones and is often disseminated through the limestone in minute flakes and in larger foliated masses. It is also prominent as layers in some schists and gneisses and when present in considerable amount the graphitic gneiss or schist is sometimes mined for the graphite. In mining districts it is often seen coating the walls of veins and mixed with the talcose gouge. No extensive deposits of good quality graphite are known to occur in the State, but a few small deposits have been worked for the manufacture of paints and lubricants. Much of the graphite of California is so intimately mixed with silica that its separation as pure material is an expensive operation. It is typically a constituent of metamorphic rocks and as such may be found in every county.

Calaveras County: It occurs in the copper-bearing schists, and specimens have come from Copperopolis and Campo Seco.

Del Norte County: The limestone near Gasquet contains foliated plates of the mineral.

Fresno County: Prominent mineral in the rocks near Dunlap and at Borer Hill. Graphite schists occur on the Kean and Ruth ranches, four miles east of Squaw Valley; also on Sycamore Creek near Trimmer.

Humboldt County: Occurs near Eureka. Small deposits at Otto Rest on South Fork of Trinity River.

Imperial County: A good grade of graphite is found seven miles northwest of Coyote Wells on the San Diego and Arizona Railroad.

Inyo County: Graphite occurs eighteen miles east of Independence.

Los Angeles County: Found in the schists at West Carbondale and in the limestone near Elizabeth Lake. A deposit of graphite gneiss occurs in the Verdugo Canyon, ten miles northeast of Los Angeles. It occurs as a stratum running from the head of San Francisquito Canyon across to Charles Canyon.

Mendocino County: A deposit occurs about fifteen miles east of Point Arena which has been worked for paint and lubricant.

Monterey County: Graphite is disseminated in the limestones and metamorphics of the Santa Lucia range, south of Monterey.

Riverside County: Flakes of graphite are prominent with the brucite in the limestone at Crestmore. Good quality is found near Temecula.

San Bernardino County: Large deposits are said to exist in San Bernardino mountains, fifteen miles from East Highlands. It is also found as a constituent of the limestone near Colton and near Oro Grande.

San Diego County: Graphite in mica schist occurs near Masons.

Santa Cruz County: Occurs in flakes and foliated masses at the limestone quarries near Santa Cruz.

Siskiyou County: Reported from head of Kelsey Creek in Marble Mountain District, and from headwaters of East branch of Seiad Creek.

Sonoma County: A deposit near Guerneville, one four miles west of Healdsburg and one four miles south of Petaluma, are known in this county. Specimens have come from Cazadero, Pine Flat and Santa Rosa.

Tulare County: Graphite occurs in metamorphic rock in Drum Valley, north of Auckland, and on quartz at Three Rivers.

Tuolumne County: Large foliated masses and dull earthy masses of the mineral occur in the limestones north of Sonora, near Columbia. The mineral was formerly mined here, but none is now produced.

3. SULPHUR.

Native sulphur, S.

Orthorhombic. Common in small crystal coatings and incrustations. Sulphur—yellow color. Resinous luster. H = 1.5—2.5; G = 2.
Refractive indices: $\alpha = 1.950$; $\beta = 2.043$; $\gamma = 2.24$.
Burns with a blue flame.

Yellow sulphur is common in the vicinity of geysers, hot springs and volcanoes as sublimations from the emitted hydrogen sulphide gas in contact with the air, and as precipitations from solfataric waters. It is commonly found in gypsum beds as a reduced product, and in association with borax. No workable deposits are known in the State. For the manufacture of sulphuric acid, pyrite deposits and pyrite concentrates from the gold and copper mines are utilized.

Colusa County: On the banks of Sulphur Creek solfataric action has produced fine crystallized masses and granular coatings of the mineral, sometimes in association with cinnabar and good specimens have come from the Manzanita mine, and also from the Elgin mine.

Imperial County: The mud volcanoes near Volcano have rims of sulphur crystals associated with gypsum and salt. These volcanoes have been described by Hanks[4]. Small deposit on the east slope of Coyote Mountain.

Inyo County: Sulphur Bank on Owens Lake, near Olancha contains a deposit of the mineral. Specimens of sulphur with fluorite and gypsum have been found in the Defiance mine. A small deposit is reported in the mountains east of Big Pine and also one mile southwest

of Coso Hot Springs. Native sulphur at the Sunshine mine, Last Chance Mountains.

Kern County: On both sides of the San Joaquin Valley impure beds of gypsum and limestone occur, having considerable sulphur intermixed. It is mixed with alum in the Sunset district.

Lake County: At the Sulphur Bank quicksilver mine, situated on Clear Lake, a very interesting deposit of sulphur occurs which was described by Le Conte and Rising[1] and by Becker[1]. The black basaltic rock which outcrops on the lake has been bleached white and altered to a porous mass of silica by the action of the sulphuric acid fumes coming from several hydrogen sulphide vents. The pores and cavities of this altered mass of rock have had deposited in them brilliant crystals of sulphur and acicular crystals of cinnabar. The forms of the sulphur crystals are: (111), (113), (011), (101), and (001). Sulphur was obtained in considerable quantity from this deposit before it was discovered to overlie the much richer deposit of cinnabar. Sulphur also occurred associated with borax at Little Borax Lake, just south of Clear Lake.

Mariposa County: Crystals of sulphur have been found with cinnabar on Horseshoe Bend Mountain, near Coulterville.

San Bernardino County: Occurs at Searles Borax Lake as one of the many associated minerals of borax.

Sonoma County: Native sulphur is found at the Geysers.

Tehama County: A large crystalline deposit is said to exist on the south slope of Lassen Butte in the northeastern part of the county.

Trinity County: Found on the Supan property, six to eight miles from Mt. Lassen.

Ventura County: Deposits occur in Sulphur Mountain, three miles east of Fillmore, and at the borate deposit of the Frazier Mountains.

SEMI-METALS.

4. ANTIMONY.

Native antimony. Sb.

Hexagonal-rhombohedral. Generally massive. Perfect basal cleavage. Very brittle. Color and streak tin-white. H = 3 — 3.5. G = 6.65 — 6.72. Metallic luster.

Heated on charcoal, dense white fumes and a white coating on the coal near the assay are obtained. Completely vaporizes without odor.

Masses of metallic antimony are sometimes found associated with the sulphide of antimony, stibnite, but the mineral is comparatively rare.

El Dorado County: Specimens of native antimony have come from Pleasant Valley.

Kern County: Large nodules of metallic antimony, coated with white oxide of antimony have been found on Erskine Creek, east of Vaughn. It has been found in the Buffalo mine and antimony mines of the San Emidio Mountains in the southwestern part of the county.

5. ARSENIC.

Native arsenic, As.

Hexagonal-rhombohedral. Generally granular massive in reniform shapes. Perfect basal cleavage. Brittle. Color and streak tin-white but surface usually tarnishes dark gray or black. Luster metallic. H=3.5; G=5.63—5.73.

Heated on charcoal, very volatile white fumes are obtained similar to antimony, but more difficult to catch on the coal; fumes have strong garlic odor.

Metallic arsenic is a rare mineral and its existence in the State is doubtful. Arsenic is common in the concentrates of many of the gold mines, but it comes from such minerals as arsenopyrite or arsenical tetrahedrite.

Monterey County: The native metal was said to have been found in the old Alisal mine on El Rancho Alisal, about eight miles southeast of Salinas, in the foothills of the Gabilan range, W. P. Blake[9]. This mine contained a small body of argentiferous galena and sphalerite.

6. BISMUTH.

Native bismuth, Bi.

Hexagonal-rhombohedral. Usually in arborescent-reticulated shapes. Color silver-white with reddish tinge, tarnishing dark brown. Luster metallic. H=2—2.5; G=9.70—9.83.

Heated on charcoal, it gives a lemon yellow coating. Mixed with a flux of potassium iodide and sulphur and fused on charcoal, the coating is bright red, which distinguishes it from lead, which is yellow.

Crystals and veinlets of metallic bismuth sometimes accompany ores of bismuth, cobalt, silver and gold. It is also occasionally found in pegmatitic veins. When bismuth occurs in the concentrates of gold and copper ores it probably is present as a sulphide.

Inyo County: Found with bismuthinite at Big Pine Creek and at Antelope Springs, Deep Spring Valley.

Mono County: Specimens have occurred at Oasis.

Nevada County: The concentrates of the Providence mine, Nevada City, contained the element, according to Lindgren[6].

San Diego County: Upwards of a hundred pounds of metallic bismuth have been obtained from the pegmatitic vein of quartz, lepidolite, feldspar, tourmaline and amblygonite at the Stewart mine of the American Lithia company, at Pala. The mineral occurred in platy and long

prismatic crystals, one of which was a pseudomorph after feldspar. The occurrence was described by Kunz[5]. The native bismuth is also found in small metallic cleavages in lepidolite at the Victor mine Rincon. Rogers[3].

Tuolumne County: Minute crystals of bismuth have been observed in the gold ore at the Soulsby mine.

7. TELLURIUM.

Native tellurium, Te.

Hexagonal-rhombohedral. Generally massive. Perfect prismatic cleavage. Brittle, and sectile. Color and streak tin-white. Luster metallic. H=2.—2.5; G=6.1—6.3.

Heated on charcoal, it gives dense white coating similar to antimony. Powder heated in a test tube with a few drops of concentrated sulphuric acid gives a violet solution.

Metallic tellurium is sometimes found in association with the tellurides of gold, silver, lead and bismuth, but it is of rare occurrence. It is occasionally found in the gold concentrates when not visible in the ore, and has been reported from some of the mining districts of the State.

Calaveras County: Carson Hill, a low hill on the north bank of the Stanislaus River, a few miles south of Angels, was one of the most noted places along the Mother Lode for telluride minerals, and it was here that the two new tellurides, calaverite and melonite were found. The old Stanislaus mine and the Melones mine contained foliated masses of native tellurium with the gold tellurides.

Shasta County: Native tellurium was found in the Eureka mine, near Churntown.

Tuolumne County: Some metallic tellurium has been found associated with tellurides of gold and silver in the mines near Tuttletown and Jamestown.

METALS.

8. GOLD.

Native gold, Au.

Isometric. Good crystals are rare. Common in grains, scales, plates and arborescent forms. No cleavage. Highly malleable and ductile. Color gold-yellow. H=2.5—3.0; G=15.6—19.3.

Unaffected by any single acid, but soluble in the combined hydrochloric-nitric acids, called aqua regia. Its insolubility in nitric acid distinguishes it from chalcopyrite and pyrite.

Gold has a very wide distribution in California and it has always been the chief mineral product of the State. It has been found in every county and is now produced in two-thirds of them. Practically

all of the gold exists as the native metal, either as free gold in the quartz or else mechanically mixed with the sulphides of iron, copper, lead or zinc. Tellurides of gold occur, but they are quite subordinate in quantity.

Crystals, arborescent groups, spongiform masses, wires, plates, scales, grains, nuggets and every shape known for gold, have been found. Cubes, rhombic-dodecahedrons and octahedrons are the prevailing forms of the crystals. The forms given by E. S. Dana [1] and Alger[1] for some placer gold crystals were: (111), (311), (18.10.1) and (421), with twinning on the octahedral plane. Crystalline masses and nuggets of large size have occurred in the placer gravels and in the pockets of quartz veins. One found in 1854 at Carson Hill, Calaveras County, weighed 2,340 troy ounces, and another found in 1860 at the Monumental mine, Sierra Buttes, weighed 1,596 ounces. Many valuable nuggets and masses have been found and Hanks[4] gives a descriptive list of some of them.

Gold in quartz is the usual association and the mineral is often in the quartz in such a finely divided state as to be invisible, even in high grade rock. Flaky gold has been found implanted on clear quartz crystals at Placerville and elsewhere.

Gold in pyrite, or "auriferous pyrite," is abundant and this gold-bearing pyrite is the source of much of the gold produced in the State.

Gold in arsenopyrite is also common in the Mother Lode region and in the Alleghany district, Sierra County.

Gold with calcite as a gangue mineral is not uncommon, and in some mines considerable calcite is found with wires and scales of included gold. Lenticular masses of calcite with much gold are found in Minersville, Trinity County. Diller[1]. It has been found with calcite at the Palma mine, Inyo County, at the Yellowstone mine, Mariposa County, in the Soulsby mine, Tuolumne County, and in the Calico district, San Bernardino County.

Gold in barite is uncommon, yet barite is found to be a gangue mineral in the copper-gold districts as well as in the silver-lead districts. It occurs in barite at Pine Grove, Nevada County, in the Morning Star mine, Big Bend, Butte County, at the Malakoff mine, North Bloomfield, Nevada County, and in the barite of some of the Shasta County copper mines.

Gold in cinnabar is an exceptional occurrence, yet the association has been noted in a few localities. At the old Manzanita mine in the Sulphur Creek district, Colusa County, minute specks of gold occurred in the cinnabar and implanted on cinnabar crystals; also in the old Redington or Boston mine, Knoxville, Napa County, some gold has

been found with the cinnabar, and likewise near Coulterville, in the Horseshoe Bend mountain, Mariposa County.

In addition to the above, gold has been observed with graphite, galena, altaite, petzite, hessite, tetradymite, calaverite, native tellurium, chalcopyrite, chalcocite, native bismuth, stibnite, sphalerite, tetrahedrite, fluorite, chalcedony, jasper, cuprite, magnetite, hematite, limonite, pyrolusite, dolomite, ankerite, rhodochrosite, siderite, albite, rhodonite, mariposite, chlorite, roscoelite, talc, serpentine, asbestos, chrysocolla, and asphaltum. Gold is not confined to one class of rocks, although the gold-bearing quartz veins are principally in metamorphic schists and slates. The original source of the gold has been the igneous rocks and it has been found in granites, syenites, monzonites, granodiorites, diorites, rhyolites, quartz-porphyries, andesites, porphyrites and diabases. It has been deposited, with quartz or as impregnations, in such metamorphic rocks as gneisses, amphibolites, chlorite-schists, talc-schists, mica-schists, slates and quartzites, and in sedimentary conglomerates, sandstones and shales.

The great supply of gold was brought into California with the intrusion through the Mesozoic sediments of the mass of igneous granitic rock which forms the core of the lofty Sierras. The intrusion of the great plutonic mass lifted on high the overlying sediments, tilted, folded, faulted, and metamorphosed the Cretaceous sediments on the flanks of the uplift into slates, schists, quartzites and crystalline limestones; and in the joints and fissures of the granitic and metamorphic rocks, gold-bearing quartz was deposited, forming veins and seams of the precious metal.

Then followed a long period of erosion in the Cretaceous and Tertiary time in which the high mountain masses were planed down nearer to their present levels, and the gold became concentrated and deposited with the gravels along the stream beds, and in the valleys and canyons, forming the numerous placer deposits.

Volcanic eruptions took place in the late Tertiary and much of the surface in the northern counties became covered with thick layers of rhyolitic and andesitic lavas and tuffs. The old placers became buried under this mass of volcanic rock and mud, and new river channels, valleys and canyons, and new placer deposits were formed by the extensive erosion during the late Pliocene and early Quarternary time.

Some gold is found in the Coast Range and some is mined in the southern counties, but the great bulk of the precious metal comes from the northern half of the State and from those counties bordering on, and intersected by, the Sierra Mountains.

Gold occurs in so many localities in the State that it would be impossible to cite all of them. The literature on the gold deposits is also extensive.

The leading gold-producing counties of the State are: Amador, Butte, Calaveras, El Dorado, Kern, Mariposa, Nevada, Placer, Sacramento, Shasta, Siskiyou, Sierra, Trinity, Toulumne and Yuba.

Amador County: Gold is the chief mineral of the county. The Mother Lode crosses the county and some of the famous mines are: the Argonaut and Kennedy mines at Jackson; the Bunker Hill, Fremont, Keystone and Amador mines at Amador City; the Central Eureka mine at Sutter Creek; and the Plymouth mine at Plymouth.

Butte County: Much of the gold of this county has come from the dredgers along the Feather River at Oroville and other towns. Cherokee Flat, Forbestown and Magalia are old noted places.

Calaveras County: The Mother Lode crosses this county and gold is the principal mineral. Some of the noted mines are: the Utica, Angels and Lightner mines at Angels Camp; Gwin mine near Mokelumne Hill; Sheep Ranch mine at Sheep Ranch, and the Melones and Morgan mines on Carson Hill.

El Dorado County: Placerville, Georgetown, El Dorado, Grizzly Flat, Shingle Springs and Greenwood are all noted districts.

Kern County: The Yellow Aster mine at Randsburg has been the largest producer of the southern mines. The Amalie, Cove, Tehachapi, Mojave, Rand and Stringer districts are well-known.

Mariposa County: The Princeton and other mines on the Mariposa Estate, the mines near Coulterville, Hornitos and Bagby were all noted producers. Most of the mines of the county are now idle.

Nevada County: The Grass Valley and Nevada City mines have been large producers of the precious metal. The Empire, North Star, Allison Ranch, Providence and Union mines are among the most noted in the State.

Placer County: Auburn, Colfax, Emigrant Gap, Gold Run, Blue Canyon, Dutch Flat, Michigan Bluff, Forest Hill and Weimar are historical mining districts, mostly for placer mining.

Sacramento County: Most of the gold of this county is obtained by dredging along the ancient courses of the American River. Fair Oaks, Folsom and Natomas are some of the places.

Shasta County: This is more of a copper county, but considerable gold is produced. The largest quartz mines are in French Gulch and Harrison Gulch. Much of the gold is obtained from smelting copper ores.

Sierra County: The gold mines are mostly on the Sierra Buttes, on Kanaka Creek, and near Downieville, Alleghany and LaPorte.

Siskiyou County: Both quartz and placer mining are carried on in the county. Sawyer's Bar, Scott Bar, Humbug Creek, Callahan, Happy Camp, Quartz Valley, Klamath River, Scott River are noted districts.

The Black Bear group of quartz mines has been the largest producer. Fine large nuggets have come from the placers.

Trinity County: The principal mines are centered around the famous towns of Minersville, Trinity Center, Deadwood, Douglas City, and Carrville.

Tuolumne County: The Mother Lode crosses the county and many noted mines are along it. Sonora, Soulsbyville, Tuolumne, Jamestown, Tuttletown, Big Oak Flat, Chinese Camp, Stent and Groveland are all noted places.

Yuba County: Most of the gold of this county is obtained from dredgers along the Yuba River Some quartz and pocket mining is also done.

The counties of Del Norte, Fresno, Humboldt, Inyo, Lassen, Los Angeles, Madera, Modoc, Mono, Plumas, Riverside, San Bernardino and San Diego produce gold. It occurs in every county in California.

GOLD AMALGAM.—A native alloy of gold and mercury very rarely found.

Mariposa County: It occurred in some of the mines near Mariposa and was analysed by Sonnenschein[1].

Analyses:	Au	Hg
	39.02	60.98 per cent
	41.63	58.37

Nevada County: It was reported from the Odin shaft, Grass Valley, by Lindgren [6].

ELECTRUM.—A pale yellow alloy of gold and silver of rather frequent occurrence where considerable silver is found with gold.

Imperial County: Considerable quantity of electrum is said to have been found in the Oro Plata mine, in the extreme eastern part of the county.

Madera County: Wire electrum occurred with gold in Fine Gold Gulch.

Placer County: It occurred with the gold in the Ophir District, according to Lindgren[4], and was analysed by Hillebrand.

Analysis:	Ag	Au
	27.91	72.09 per cent

BISMUTH GOLD.—An alloy containing about 60 per cent gold and 40 per cent bismuth.

El Dorado County: Observed in the Coon Hollow mine near Placerville.

9. SILVER.

Native silver, Ag.

Isometric. Crystals rare. Generally in wires, arborescent shapes and massive. Color silver-white but soon tarnishes to dark brown. Malleable and ductile. Metallic luster. H=2.5—3; G=10.5.

Soluble in nitric acid. A few drops of hydrochloric acid added to the nitrate solution precipitates white curdy silver chloride, which soon turns brown and is soluble in ammonia.

Native silver has not been found in any large masses in the State, yet the element is quite universally present in the gold and copper districts, and occasionally arborescent crystallizations, wires and thin sheets are found in the mines of these metals. It is more common, however, in the silver-lead districts, where it occurs often near the walls of veins or in the vicinity of intrusive dikes, as a reduction product.

Alpine County: The Silver Mountain district has yielded good specimens of native silver.

Calaveras County: Occurred in arborescent forms with the copper ore at Quail Hill.

Inyo County: This is one of the silver counties of the State and has several deposits of argentiferous galena, tetrahedrite and silver-antimony minerals, formed along the contact between limestone and the granitic rock of the Inyo, Coso and Argus ranges. Fine specimens have come from the old Cerro Gordo district and also from the Kearsarge district near Independence.

Kern County: In the Amalic district and near Garlock it occurs with the silver minerals.

Los Angeles County: Native silver was associated with argentite, and with cobalt and nickel minerals, at the Kelsey mine near San Gabriel Canyon.

Mono County: In the silver district at Blind Spring Hill, near Benton, the native metal was frequent, associated with tetrahedrite and partzite. The Diana mine and the Comache mine of this district have produced good specimens. At Bodie it has been found with the copper-gold ores. In the Sweetwater range, north of Bridgeport, native silver occurs associated with gold, cerargyrite and argentite.

Placer County: Occurs as one of the associated minerals with gold at the Ophir mine, Lindgren[4].

Plumas County: Some native silver has been found in the old Pocahontas mine associated with native copper and cuprite.

San Bernardino County: This county has long been known for its deposits of silver haloids. The Calico district, described by Lingren[1] and Storms[1], the Grapevine district, the Silver Reef district and the Silver Mountain district have all produced some native silver with the cerargyrite and embolite of the mines. Native silver with gold occurs in the Avawatz Mountains.

Shasta County: Native silver is rare in the copper deposits of this county, but an occasional arborescent specimen has been found at the Bully Hill, Afterthought and other mines. Fine crystallized specimens occurred in the old Excelsior mine, Copper City, Fairbanks[2]. Native silver in aborescent crystallization associated with stephanite, galena and sphalerite, in a calcite-quartz gangue occurs at the Igo Consolidated mines.

10. COPPER.

Native copper, Cu.

Isometric. Good crystals rare. Generally in wires, thin sheets and arborescent crystallizations. No cleavage. Malleable and ductile. Luster metallic. Color copper-red. H=2.5—3; G=8.83.

Soluble in nitric acid—on adding ammonia the solution turns deep blue.

Some metallic copper has been found in most of the copper mines of the State, but no deposits of the native metal are known. It is frequently mixed with cuprite and malachite in the oxidized zone of copper deposits, or found as coatings along the walls of copper veins, or in the vicinity of intrusive dikes, which have brought about a reduction of the ores. Most of the localities cited for chalcopyrite have yielded some native copper.

Alameda County: At the Alma pyrite mine on Leona Heights, east of Oakland, fine arborescent crystallizations of the native metal are occasionally found. The minerals of this mine have been described by Schaller[1].

Amador County: Arborescent masses occurred in the old Newton mine.

Calaveras County: Some of the mines along the copper-sulphide belt, especially at Copperopolis and at Campo Seco, have produced some of the mineral. At Mokelumne Hill it occurred associated with silver.

Colusa County: Found in serpentine with cuprite and melaconite at the Gray Eagle mine, and also at the Lion mine.

Del Norte County: Some large pieces have come from the Diamond Creek district and from the Pearl and Occidental mines.

El Dorado County: The old Cosumnes mine, near Fairplay, has yielded small masses of native copper with bornite, chalcocite and cuprite. The Alabaster Cave mine near Newcastle, the Cambrian mine near Placerville, the Ford mines near Georgetown and the Oest mine near Auburn, have had native copper with the cuprite.

Fresno County: Thin sheets have been found in quartz east of Fresno City.

Glenn County: Large float pieces have been found a few miles north of Chrome Mountain and also on Elk Creek.

Humboldt County: Many specimens occur on Red Cap and Boise creeks and also in the Horse Mountains.

Inyo County: The copper deposits in the Ubehebe Mountains contain the oxides of copper and some native copper.

Lake County: Observed as finely disseminated particles in the serpentine of this county.

Lassen County: Native copper in epidote rock at the Lummis mine.

Los Angeles County: At the Free Cuba mine, near Acton.

Mariposa County: Massive with malachite in the Copper Queen mine.

Mendocino County: Sheets and grains of metallic copper occur at Red Mountain, fifteen miles southeast of Ukiah. It is also seen in the serpentines in Lost Valley.

Merced County: Occurs with quartz and chalcopyrite in the Victor Bonanza mines.

Modoc County: Observed near Fort Bidwell with malachite and limonite.

Mono County: Found sparingly in the Lundy and Benton districts.

Monterey County: Occurs disseminated in serpentine on Table Mountain near Parkfield; also in serpentine with chalcopyrite near summit of Santa Lucia Range, seven miles from Santa Lucia.

Placer County: At the Algol mine near Spenceville in sheets and hackly masses; at the Valley View mine, six miles from Lincoln; and near Todd on magnetite. Lindgren[4] reported it as one of the minerals of the Ophir district; at Meadow Lake with cuprite and chalcocite.

Plumas County: Found with rhodonite at Mumford's Hill. Large lumps occurred with cuprite, malachite and native silver in the old Pocohontas mine, Indian Valley.

Riverside County: In the McCoy Mountain district.

San Luis Obispo County: At the Tiptop mine, ten miles north of San Luis Obispo, and on Chorro Creek in small pieces.

Shasta County: This is the principal copper county and many of the mines have produced specimens of arborescent copper and occasionally compact masses. The Bully Hill mines, Copper City mines, Shasta King mine, Mountain Copper mine, Mammoth mine, Balaklala mine and Kosk Creek mines may be mentioned.

Siskiyou County: Pieces have been found at Preston Peak with pyrite and chalcopyrite.

Tehama County: On Elder Creek and at White Bluff.

Tulare County: Masses have been found on the Middle Fork of the Tule River, about thirty miles east of Porterville.

11. MERCURY—Quicksilver.

Native mercury, Hg.

Liquid. Forms small fluid globules in the matrix which is usually cinnabar. Color tin-white. Brilliant metallic luster. G=13.59.

Vaporizes at comparitively low heat and disappears; the vapors are invisible. Soluble in nitric acid.

Liquid globules of mercury are common in most of the cinnabar mines, formed either by reduction of the sulphide or by sublimation of mercuric vapors. It prevails in deep workings and in those parts of ill-ventilated mines where intense heat is developed by the decomposition of iron sulphides. It is also frequently found near the walls of cinnabar veins. Most of the localities cited for cinnabar will serve for the metallic element.

Kings County: Occurred in the Kings mine with serpentine.

Lake County: In the Wall Street mine at was abundant in the gravels and was also associated with cinnabar in quartz veins. Occurred also in the Big Injun and Big Chief mines, west of Middletown.

Napa County: Frequent in the mines at Oat Hill and Knoxville.

Orange County: Small amounts of native mercury associated with veins of barite have been reported from a locality two miles east of Tustin in a hill of sandstone.

San Benito County: In the cinnabar deposits at New Idria. Occurs with cinnabar in serpentine at the Alpine Quicksilver mine.

San Francisco County: Liquid globules have been found in silicious rock near Twin Peaks.

Santa Clara County: Very prevalent in some of the shafts at New Almaden.

Sonoma County: Prominent in the New Sonoma mine, Pine Flat district, sixteen miles northeast of Healdsburg. In the Rattlesnake mine much native quicksilver occurred, as was also the case with the Pioneer Socrates mine. Present in the Bright Hope (Esperanza) mine near "The Geysers"; in the Clear Quill mine about one mile from the Great Eastern mine, associated with cinnabar.

Trinity County: Found at the Altoona mine with cinnabar.

12. LEAD.

Native lead, Pb.

Isometric. Crystals rare. Usually in small plates and pellets. Malleable. Color lead-gray. H=1.5; G=11.37.

Heated on charcoal, it gives a yellow coating, which remains unchanged in color with the potassium iodide and sulphur flux.

Metallic lead is an exceedingly rare mineral and its reported occurrence as a true mineral is sometimes doubtful. Small bits of lead which

are now and then found in the placer gravels may be portions of lead bullets, but the occurrence of the metal in deep placer mines is indicative of its origin as a natural reduction product.

Butte County: Some pieces of metallic lead found in a placer at Magalia were believed by Hanks[6] to be flattened bullets. Small angular fragments of native lead have been found at a prospect 14 miles east of Chico, on the West Fork of the Feather River, Rogers[5].

Kern County: Several pieces of metallic lead have been found in the dry washings at Goler.

Placer County: Small pellets of native lead have been found in a placer mine in North Ravine, in the Edgewood district, adjoining the Ophir district.

13. TIN.

Native tin, Sn.

Rounded grains. Color tin-white. Metallic luster. H=2; G=7.18.
Heated on charcoal, it gives a slight yellowish coating, which becomes bluish-green when moistened with cobalt nitrate and intensely heated.

Metallic tin is a rare mineral and there is some doubt regarding the origin of some of the small pieces found in the State.

Humboldt County: Bits of metallic tin have been observed in the sluices at Orleans.

Siskiyou County: Small pieces of tin have been found in the gravels at Sawyers Bar.

Tuolumne County: Several pieces of native tin were found in the sluices of the White Lead gravel claim, near Columbia.

14. ZINC.

Native zinc, Zn.

Hexagonal, rhombohedral. Crystals very rare. Color grayish white. Metallic luster. H=2; G=6.9—7.2.
Heated on charcoal, it gives a yellow coating while hot, whitish cold. Coating becomes yellowish-green when moistened with cobalt nitrate and intensely heated.

A rare mineral, but of probable occurrence in the State.

Shasta County: Specimens of metallic zinc were found some years ago about five miles from Round Mountain and their occurrence was reported by Fairbanks[2]. The specimens are somewhat columnar in appearance and had some rock attached to them when found.

15. PLATINUM.

Native platinum, Pt.

Isometric. Generally occurs in grains and small nuggets. Malleable and ductile. Color light steel-gray. Metallic luster. H=4 — 4.5; G=14 — 19.

Platinum and the platinum group of minerals are soluble only in aqua regia. To detect small amounts of these minerals in sands, first concentrate by panning until a sufficient number of the gray metallic grains are obtained. Dissolve in aqua regia and in the clear solution add a few drops of potassium chloride, which will precipitate orange-yellow potassium platinic chloride.

Gray metallic grains and small nuggets of platinum were early observed in some of the gold-bearing black sands of the streams and beaches, and also in the concentrates from the gold washings. Little attempt was made to save this precious metal, and it is only recently that any record has been kept of the production. It is rather a constant associate of the gold in most of the districts, and its origin lies doubtless in the serpentine rocks, in close association with the chromite. While it has a widespread occurrence in the State, it has not been definitely detected as a constituent of any of the rocks. Some platinum is recovered in electrolytic refining of blister copper from the Iron Mountain mine, Shasta County. Platinum has been identified in lead carbonate ore, associated with gold, silver, copper values, in the Piute mine, near Cima, San Bernardino County.

Analyses of California platinum have been made by Deville and Debray[1] and by Genth[1].

	Pt	Ir	Iridos	Pd	Rh	Fe	Cu	Au	SiO_2
Deville and Debray	85.50	1.05	1.10	0.60	1.00	6.75	1.40	0.80	2.95
Genth	90.24	2.42	0.68	some	some	6.66	---	---	---

Most of the platinum is alloyed with iridium, osmium, palladium and other metals of the platinum group, and much of it would be classed as platiniridium. Many of the black sands have been investigated by Day and Richards[1].

Butte County: It is a constituent of the black sands of Feather River and some of its tributaries, and the largest production is from the dredging operations at Oroville. It is present in the concentrates of Butte Creek, Brush Creek, Magalia, Cherokee, and Buchanan Hill.

Calaveras County: Observed in the concentrates at Douglas Flat and Mokelumne Hill.

Del Norte County: In the black sands at Cresent City, and with gold, iridium and osmium in the sands of the Smith River Basin.

Humboldt County: Early mentioned as one of the constituents of the gold-bearing beach sands at Gold Bluff. Found in the concentrates at Orleans, Trinidad, Wilson Creek and China Flat.

Inyo County: Said to have been found in the concentrates of the Mt. Hope mine, near Citrus.

Kern County: Traces of the metal have been observed in the sands at Kane Springs.

Mariposa County: Reported to have been found in Devil's Gulch near the junction of Devil Creek and south fork of the Merced River, about five miles from Jerseydale. The ore is said to carry mainly platinum, gold and small amounts of cobalt, nickel and tin.

Mendocino County: In the beach sands near Little River. Platinum minerals occur in the superficial deposits in the valley near Hopland. Gold and osmiridium accompany the platinum.

Nevada County: In the concentrates of the Rough and Ready district and in considerable amounts at Relief Hill.

Placer County: In the black sands on the North Fork of American River, at Butcher, East Auburn, Blue Canyon, and Michigan Bluff. The sands of the Deadwood district contain gold and platinum.

Plumas County: In the concentrates at Genessee, La Porte and Rock Island Hill.

San Luis Obispo County: Observed in some of the beach sands.

Santa Barbara County: In the beach sands at Lompoc and north of Point Sal.

Santa Cruz County: In some of the beach sands of the county.

Shasta County: Found in the sands at Redding and on Cottonwood Creek. The black sands of Beegum Creek contain platinum, iridium and a little gold.

Siskiyou County: Observed in the sands at Callahan, Castella, Henley, Happy Camp, Sawyers Bar, Oak Bar, Fort Jones, Hornbrook, Cecilville, Klamath River, and Rock Ranch.

Tehama County: In the sands near Beegum.

Trinity County: Early observed as a constituent of the black sands of the Trinity River and its tributaries, and nuggets weighing several ounces have come from the county. Its presence has been shown in the sands at Douglas City, Burnt Ranch, Junction City, Big Bar, Hawkins Bar, and in the Hayfork district.

Ventura County: It has been observed in minute quantities in some of the beach sands.

Yuba County: Found in the concentrates at Indian Hill, Camptonville, and in the Brownsville district.

16. IRIDIUM.

Native iridium, Ir.

Isometric. Generally in grains. Color silver-white. Metallic luster. H=6—7; G=22.6—22.8.

Practically insoluble even in aqua regia.

Steel-gray grains of iridium have been detected with the platinum in some of the sands, but most of this metal is in alloy with platinum.

17. PLATINIRIDIUM.

Native alloy of platinum and iridium, PtIr.

Isometric. Generally in grains and nuggets. Color light steel-gray. Metallic luster. H=6—7; G=22.65—22.84.

Much of the so-called platinum of the State is really this alloy, and several nuggets of a few ounces weight have been found along the Trinity River.

18. PALLADIUM.

Native palladium, Pd.

Isometric. Minute octahedrons. Generally in grains. Color light steel-gray. Malleable. H=4.5—5; G=11.3—11.8.

An associate of the platinum but in small amount. It is usually alloyed with platinum or iridium.

19. IRIDOSMINE.

Native alloy of iridium and osmium, IrOs.

Hexagonal, rhombohedral. Generally in grains. Cleavage perfect basal. Color light steel-gray. Metallic luster. H=6—7; G=19.3—21.12.

This alloy is a frequent associate of the platinum and an analysis of it by Deville and Debray[1] shows the presence of the rarer metals, rubidium and ruthenium.

Ir	Rd	Ru	Os
53.50	2.60	0.50	43.40

Siserkite is a variety with not over 30 per cent iridium. According to Genth[1] the composition of some of the gray metallic grains is:

Siserkite	49.4 per cent
Platinum	48.4
Platiniridium	2.2
Palladium and rhodium	some

20. OSMIUM, RHODIUM and RUTHENIUM.

Rarer metals of the platinum group and generally found in alloy with the platinum or iridium.

21. IRON.

Native iron, Fe.

Isometric. Generally massive. Malleable. Color steel-gray to iron-black. Metallic luster. H=4—5; G=7.3—7.8. Strongly magnetic.

Its strong magnetism and the fact that it is malleable distinguishes it from all other iron minerals, since these are brittle.

Iron occurs native either as telluric iron or as meteoric iron. Telluric iron is sometimes found in basaltic rocks, but its occurrence in this

form is not known in the State. Meteoric iron has been found in at least four localities and analysed. Nickel is always present and sometimes cobalt, phosphorous, graphite or diamond.

El Dorado County: A meteorite weighing 85 pounds was found at Shingle Springs in 1871 and was analysed by Shepard[1].

Analysis:

Fe	Ni	Insol	
88.02	8.88	3.50	=100.40 per cent

Kern County: A meteorite found in the San Emidio Mountains in 1888 weighed about 80 pounds. It was unfortunately crushed before its identity was recognized and only fragments were saved. Merrill[1] described the material and it was analysed by Whitfield[2]. It was erroneously called the San Bernardino meteorite.

Analysis:

Fe	Ni	Co.	
88.25	11.27	0.48	=100 per cent

San Bernardino County: An irregular-shaped mass of meteoric iron was found in the Ivanpah district in 1880 which weighed about 117 pounds. Analysed by Shepard[3] and by C. Gehring.

Analyses:

	SpG	Fe	Ni	Co	P	C	S	SiO_2	Graphite	
Shepard	7.65	94.98	4.52	--	0.07	0.10	--	--	--	=99.67
Gehring	8.076	94.86	4.47	0.26	tr.	0.12	tr.	0.04	0.07	=99.82

This meteorite is now in the Museum of the California State Mining Bureau.

Trinity County: A small oval-shaped mass weighing 19 pounds was found at Canyon City about 1875. The surface was oxidized to limonite. Analysis of the purer portion was made by Shepard[4].

Analysis:

Fe	Ni	Co	P	
88.81	7.28	0.17	0.12	=96.38 per cent

22. AWARUITE.

Native alloy of nickel and iron, Ni_3Fe.

Isometric. Grains and nuggets. Tin-white to steel-gray color. Magnetic. H=5; G=8.1.

Del Norte County: Small grains of this alloy averaging 0.15 to 1.5 mm. in diameter were found in the residues from the gold washings of Smith River, associated with magnetite and chromite. Analysed by Jamieson[1].

Ni	Fe	Co	Cu	P	S	
76.69	21.37	1.20	0.04	0.04	0.06	G=7.85

CHAPTER II.

SULPHIDES.

Semi-metals.
- Realgar
- Orpiment
- Stibnite
- Bismuthinite
- Molybdenite

Metals.
- Argentite
- Galenite
- Chalcocite
- Stromeyerite
- Sphalerite
- Alabandite
- Metacinnabarite
- Cinnabar
- Greenockite
- Covellite
- Millerite
- Troilite
- Pyrrhotite
- Polydymite
- Bornite
- Cubanite
- Chalcopyrite
- Marcasite
- Pyrite

Oxisulphides.
- Kermesite
- Voltzite

SEMI-METALS.

23. REALGAR—Red Arsenic.

Sulphide of arsenic, AsS.

Monoclinic. Crystals common; also granular massive and incrustations. Color bright red to orange-yellow. Streak orange-yellow. Resinous luster. H=1.5—2; G=3.55.

Refractive indices: $\alpha=2.46$; $\beta=2.50$; $\gamma=2.61$.

Heated on charcoal, it gives volatile white fumes of arsenic oxide having garlic odor. Its red color and arsenic fumes distinguish it from other minerals.

Realgar is occasionally found with arsenical ores of silver, lead and copper, but it has been rarely seen in the State.

Alpine County: Specimins of deep red realgar coating pyrite occurred in the Monitor mine, associated with minute white octahedrons of arsenolite.

Lake County: Some realgar with orpiment is said to occur on the Eel River, about fifteen miles northwest of Bartlett Springs.

San Bernardino County: Reported as occurring about forty miles from Needles, the locality being unknown.

Sonoma County: Five miles west of Geyserville.

Trinity County: A specimen was found in calcite in the northwestern part of the county.

24. ORPIMENT.

Sulphide of arsenic, As_2S_3.

Monoclinic. Usually in foliated masses. Perfect clinopinacoidal cleavage. Sectile. H=1.5-2; G=3.4-3.5. Color lemon-yellow. Pale yellow streak. Pearly luster.

Refractive indices: $\alpha=2.4$; $\beta=2.72$; $\gamma=2.72$.

Like realgar in the reactions.

Readily distinguished from realgar by color. The two are usually associated and realgar alters into orpiment.

Lake County: Some orpiment with realgar is said to have been found on Eel River, about fifteen miles northwest of Bartlett Springs.

Trinity County: Some yellow orpiment occurs in the decomposition of the iron sulphides at Island Mountain.

25. STIBNITE—Antimonite

Sulphide of antimony, Sb_2S_3.

Orthorhombic. Long prismatic crystals, often bent and curved and with faces striated and furrowed. Cleavage perfect brachypinacoidal. Color lead-gray. Streak dark gray. Metallic luster. H=2; G=4.52—4.62.

Refractive indices: α=3.194; β=4.046; γ=4.303.

Melts in a candle flame. Heated on charcoal, it gives dense white coating and the odor of sulphur.

Stibnite is the common ore of antimony, and good deposits of the mineral exist in the State. It occurs generally as veins in granitic and metamorphic gneisses and schists. In gold and copper districts it is a common associate of the prevalent sulphides galena, sphalerite, chalcopyrite, pyrite and tetrahedrite, consequently may usually be found in those districts in small amounts. It is characteristically associated with cinnabar.

Calaveras County: Observed with gold at Mokelumne Hill and in the Mother Lode region.

Inyo County: In the Cerro Gordo district considerable stibnite was found with the silver-lead ores, and some limonite specimens recently obtained from there are evident pseudomorphs after long prismatic stibnite crystals. Large bodies of the mineral are said to occur on the western slope of the Panamint Mountains, near Wild Rose Springs, associated with the oxide of antimony. Large outcrop on east slope of Argus Mountains, between Revenue and Shepherd canyons; near Owens Lake.

Kern County: The deposits in the San Emidio Mountains at the head of the San Emidio Canyon have long been known and were the first worked in the State. Veins of the mineral also are plentiful in the mountains in the northeastern part of the county. On Erskine Creek considerable native antimony has been found in association with the stibnite. Stibnite also occurs in the Caliente district. Good crystalline specimens occur at Piute; in the Tom Moore mine, Clear Creek district; near Tehachapi; near Kernville; at Hot Springs; near Havilah; in the Cedar Creek Mining district. Occurs also at the Sierra Sue mine near Glennville.

Lake County: Some stibnite has been found with the cinnabar at Sulphur Bank, on Clear Lake.

Los Angeles County: Specimens have been found in the mountains south of Lancaster.

Mariposa County: Stibnite forms one of the sulphide minerals in the gold districts of the county.

Merced County: Fine specimens of prismatic stibnite have come from the McLeond mining district.

Mono County: Very common in the Blind Springs district, associated with the silver-lead ores, and goood specimens have come from the Comanche, Comet and Diana mines.

Monterey County: The mineral occurs about nine miles from San Lucas.

Napa County: Fibrous bands of stibnite occurred with the cinnabar at the Manhattan and the Boston or old Redington mines, at Knoxville.

Nevada County: Occurs with galena in quartz at the Red Ledge mine; also in the Mohawk Antimony mine near Nevada City.

Placer County: With gold-bearing quartz in the St. Laurence Mine, Ophir Mining district.

Riverside County: Bunches of stibnite were found at the Crowell mine, five miles southeast of South Riverside. Fine-grained stibnite was found near Corona.

San Benito County: There are numerous veins of stibnite in the county, especially in the northeastern part, in close association with the cinnabar deposits. Fine crystallized specimens have come from the Rip Van Winkel, Alta, Gleason and Shriver claims in the Antimony Mountains, northeast of Hollister, and some of the crystals have the forms: (010), (130), (110), (310), (210), (430), (113), (4.5.12), (102), Eakle[7]. Long divergent prisms of stibnite have come from the Blue Wing vein of Stayton mine.

San Bernardino County: In a boulder at the Centennial mine. A small vein of stibnite associated with wolframite was found in the Clark Mountains; occurred with the scheelite at Atolia.

San Diego County: Occurs on Laguna Mountains; also four miles west of Jacumba.

San Luis Obispo County: Occurs near head of San Simeon Creek; radiating prisms in quartz occur near Cambria; beautiful crystalline stibnite with pyrite in quartz occurs on the south fork of San Simeon Creek, near summit of Santa Lucia range.

Santa Clara County: Large divergent columnar masses have come from near Gilroy. Stibnite is also an associate of the cinnabar at the New Almaden cinnabar mines.

Sierra County: Occurs as one of the sulphides with the gold ores at Downieville.

Sonoma County: Occurs in small amounts on San Antone Creek near Marin County line.

Trinity County: Found near Weaverville with quartz and pyrite. Has been found near Hayfork.

Tulare County: Found in the Mineral King district as an associate of argentiferous galena. In quartz with pyrite on Dennison Mountains; in a quartz vein cutting slate at the Lady Alice mine, one-quarter mile south of Mineral King.

26. BISMUTHINITE.

Sulphide of bismuth, Bi_2S_3.

Orthorhombic. Usually fibrous massive. Color lead-gray. Metallic luster. H=2; G=6.4—6.5.

Heated on charcoal, it gives yellow coating and sulphur odor. Coating assumes a bright red border when fused with potassium iodide and sulphur.

The presence of bismuth has frequently been detected in the concentrates from several of the gold and copper districts, but the form in which it occurs has not in general been determined. Bismuthinite as a distinct mineral has only been noticed in a few localities.

Fresno County: Some small pieces were found in Lot 1 mine and in the second Sierra mine, Kings River district. Found about twenty miles north of Trimmer on Kings River. Specimens have been found in the northeastern part of the county.

Inyo County: Said to occur in some of the mines in the Kearsarge Mountains, near Independence.

Madera County: A constituent of the ores at Minarett Mountains, Turner[4].

Mono County: Found at Oasis with bismutite.

Riverside County: Found at the Lost Horse mine.

San Bernardino County: Was found with bismutite in the United Tungsten Copper mine, Morongo district.

27. MOLYBDENITE.

Sulphide of molybdenum, MoS_2.

Hexagonal. Usually in scales and foliated masses. Cleavage perfect basal. Color light bluish lead-gray. Streak lead-gray, sometimes with greenish cast. H=1.—1.5; G=4.7.

Soluble in nitric acid and fusible, giving sulphur odor. This readily distinguishes it from graphite, which it closely resembles.

Molybdenite is the source of the molybdenum used in steel manufacture, for which there is some demand. The mineral is widely distributed in the State, occurring in small flakes and leaves in quartz and crystalline rocks. There are few places where it is segregated sufficiently to pay for its extraction. It strongly resembles graphite but can generally be distinguished from that mineral by its lighter bluish lead-gray color and its occurrence in quartz rather than in white

limestone. In all counties having granitoid rocks some molybdenite can be found.

El Dorado County: Broad foliated plates occur at the old Cosumnes copper mine, near Fairplay, in a pegmatite vein with bornite, chalcopyrite, epidote, garnet, axinite, hornblende and orthoclase. Also in plates at Grizzly Flats.

Fresno County: In quartz at the Kings River Canyon copper mine. Good broad plates have been found in quartz rock of Green Mountain, on the south fork of San Joaquin River. Mineral occurs on Kings River, thirty miles east of Trimmer with calcite and epidote. Occurs in flakes in the White Pine district.

Inyo County: In quartz on White Mountains. A thick ledge containing much molybdenite was reported on the west side of Death Valley. Good flakes in the rocks of the Sierras near Independence. Molybdenite occurs at the Pine Creek Tungsten mine, in large masses. Occurs in a quartz vein at contact of granite and limestone at the Lucky Boy Prospect, seven miles east of Kearsarge; on Lone Pine Creek at upper part.

Kern County: Occurs with chalcopyrite and pyrite in massive white quartz in the Democrat Spring Mining district, forty-five miles east of Bakersfield.

Madera County: Plates were found in the Speckerman mine at Fresno Flat. A small deposit at Sugar Pine.

Mariposa County: Specks of the mineral occur in a lens of garnet, epidote and quartz, on the southeast slope of Mount Hoffman, Turner[5] and at Knights Creek near Big Trees, Turner [4]. Occurs in quartz in the Kinsley mining district and with molybdite, seven miles from El Portal.

Mono County: Found with molybdite at Cameron near Bridgeport; in quartz at the Minnie mine, Sweetwater Range; at Silverado Creek with molybdite, Whiting[1]. Found with molybdite one mile north of Star City. Occurs in granite about six miles west of Sweetwater, Nevada. Also found in a quartz ledge ten miles south of Fales Hot Springs.

Monterey County: Occurs in quartz on the Westcott ranch, eight miles east of Soledad.

Napa County: In quartz on Mt. St. Helena.

Nevada County: Abundant at Nevada City mixed with limonite, Genth[2]; good plates in the Mayflower mine, Nevada City; in the Excelsior mine, Meadow Lake district; in the rocks of Signal Peak; in a garnet-epidote rock near Lake Tahoe; broad plates in white quartz near Truckee.

Placer County: In a granodiorite with copper minerals at the Elder mine, about four miles west of Clipper Gap. Occurred in some of the mines of the Ophir district, Lindgren[4]. Occurs with pyrite in quartz near Cisco. Flakes of large size occur in a pegmatite near Rubicon River.

Plumas County: Broad plates occur in the Meadow Valley mining district.

Riverside County: Small flakes of molybdenite occur in thin pegmatite veins intersecting granite at a quarry about 4½ miles northeast of Corona. Occurs in a quartz vein in a quartz-biotite gneiss about thirty-five miles east of Hemet.

San Diego County: Found in granite at Campo, with malachite and chalcopyrite at Potrero and in the Grapevine mining district. The Ramona deposit at the Bour mine was concentrated and a small amount produced; with molybdite twenty miles north of Encinitas.

Shasta County: In granite on Hazel Creek and also on Tom Neal Mountain, near Delta. In aplite or alaskite on Boulder Creek near Gibson with molybdite coatings, where it has been concentrated by flotation and several tons produced.

Siskiyou County: Occurs in the Yellow Butte Copper mine, east of Weed. Occurs also near Dunsmuir.

Trinity County: With molybdite near Lewiston, Sec. 31, T. 33 N., R. 8 W., M. D. M. Occurs in quarts with some pyrite near Helena.

Tulare County: In plates at Three Rivers and in the Mineral King district, with molybdite. Fine large foliated plates of molybdenite occur in a granodiorite at the head of Kaweah River.

Tuolumne County: In a quartz vein in granite on the south side of Knights Creek, northeast of Columbia; in a quartz vein with garnet, epidote, and sphalerite, about three miles west of Tower Peak, Turner[5].

Ventura County: Reported from Frazer Mountain and McDonald Peak.

Yuba County: Plates of molybdenite with yellow molybdite occur in granitic rock near Camptonville.

METALS.

28. ARGENTITE—Silver Glance.

Sulphide of silver, Ag_2S.

Isometric. Octahedral crystals, often distorted. Commonly in arborescent and reticulated shapes. Color dark lead-gray to black. Streak black. Metallic luster. Highly sectile. H=2—2.5; G=7.3.

Heated on charcoal, it gives a slight odor of sulphur and is readily reduced to a bead of metallic silver.

Argentite is the primary silver mineral in many of the silver districts and is usually associated with other silver minerals such as cerargyrite,

stephanite, polybasite and pyrargyrite, and with argentiferous galena. Silver is found with the gold and copper of the State, but there are few distinct silver districts.

Alpine County: One of the sulphides of the Silver Mountain district, and small octahedral crystals have come from the Advance mine.

Inyo County: This is one of the few silver counties of the State and argentite has been quite common in some of the mines, especially at Cerro Gordo. Massive and crystal specimens have been prominent in the Oriental mine, Deep Spring Valley. Occurs as an important silver mineral in the Minietta Belle mine.

Kern County: Argentite crystals associated with native silver have been found in the Silver King mine, near Garlock. It occurs with tetrahedrite and pyrargyrite at the Amalie mine.

Los Angeles County: Was one of the silver minerals of the Kelsey mine, near San Gabriel Canyon, associated with native silver, erythrite, smaltite, and annabergite. Also found at Silverado with argentiferous galena.

Mariposa County: The Bryant silver mine contained argentite and ruby silver.

Mono County: Found sparingly in the Bodie and Benton districts with gold, tetrahedrite, sphalerite, chalcopyrite and galena. In the Sweetwater Range, north of Bridgeport, the mines contained argentite with gold, cerargyrite, tetrahedrite, native silver.

Nevada County: Mentioned by Lindgren[6] as occurring in the Allison Ranch mine, near Nevada City.

San Bernardino County: The silver districts of this county have produced some argentite, but in general the sulphide has not been prominent. The mines of the New York Mountains near Manvel show some, and also the old Imperial and Tiptop mines. Lava Beds district has produced crystals. It occurred to some extent with the hornsilver in the Calico and Barstow mining districts. Found with galena, chalcopyrite and pyrite in the Goldstone district.

29. GALENITE—Galena.

Sulphide of lead, PbS.

Isometric. Cubes and cubooctahedrons common. Also massive, coarse and fine granular and sometimes lamellar and foliated. Cleavage perfect cubic. Color lead-gray. Streak dark gray. Metallic luster. H=2.5; G=7.43.

Heated on charcoal, a dense lemon-yellow coating forms and a slight odor of sulphur can be detected. Is easily reduced to a bead of metallic lead.

Galenite is a very common mineral and is usually prominent in all of the gold, silver and copper districts. It is found in large and small cubes and in granular and foliated masses. Much of it is argentiferous

and forms the silver ore of the State. The characteristic associates are sphalerite, pyrite, tetrahedrite, chalcopyrite, barite, fluorite and calcite. Its two common alteration products, cerussite and anglesite, very often accompany it.

Alpine County: It occurs argentiferous in the Silver Mountain district.

Amador County: Very often found in the mines near Plymouth and along the Mother Lode.

Butte County: Occurs with chalcopyrite and quartz in the Butte Creek mining district.

Calaveras County: On Carson Hill, at Angels and in many of the mines of the Mother Lode. It occurs with sphalerite at the Buckhorn mine, Oromiento mine, Washington mine, Yaller Kid mine, Collier mine near Murphy, at West Point in the Star of the West mine and Gold Nugget mine; at the Comet mine on Mokelumne River.

El Dorado County: A sulphide constituent of many of the mines of the county. Common in cubes at Grizzly Flats. Some of the mines of the county from which it has been reported in the ores, mostly accompanied by pyrite and sphalerite, are: Grand Victory mine, Diamond Springs, Flagstaff, Mount Pleasant, Humbug mines of Grizzly Flat; Bonesett and Vandalia mines near Shingle Springs; Pilot Hill mines.

Fresno County: At Luakala mine, Contact mine, Fresno Chief mine, Jumper Claim near Spanish Peak.

Imperial County: Small veins and pockets five miles east of Picacho; large masses in Paymaster mine in the northern part of Barren Mountain near Colorado River.

Inyo County: Argentiferous galena has been the important silver ore of the county. At the old Modoc, San Felipe, Defiance, and other mines of the Cerro Gordo district it formed the chief silver ore. Common also in the Panamint Range and fine crystals have come from the Blue Wing mine. Fine-grained masses occur at the Hidalgo mine. At Blue Dick mine; Kingston Mountain; with cerussite in limestone at Chloride Cliff mine; in limestone with sphalerite at Camp Burgess; with smithsonite and cerussite in limestone at the Ophir mine, Slate Range; in the Deep Springs mining district; at the Morning Star mine, Saratoga Springs; at the Custer mine in banded masses with chalcopyrite; the Montezuma mine with cerussite, ten miles southeast of Big Pine; Marble Canyon mine, Opal mine, Lucky Hike Prospect, Nancy Hanks mine, and Daisy mine, in the Wancobe mining district; Union mine; Santa Rosa mine; in most of the mines of the Resting Springs district; with anglesite and cerussite in the Ubehebe mine; in the Darwin mining district; mined at the Monster mine on the east slope of Inyo Mountains.

Kern County: Occurs in the mines near Garlock and in the Amalie district at the Bright Star mine, Piute district associated with arsenopyrite; with scheelite in the Amalie Jawbone Canyon.

Los Angeles County: The Kelsey mine near the San Gabriel Canyon contained some galena. A small deposit occurred on Santa Catalina Island which carried a little silver and some sphalerite and chalcopyrite.

Madera County: Large cubes have come from the Star mine, Mount Raymond district; at the Gambetta mine, Grub Gulch; in the Kings Creek and Minaret districts; in the Silver Peak and De Soto mines, North Fork district; White Chief mine, Mineral King district.

Mariposa County: Mines near Bagby and Coulterville show galena and it is a frequent sulphide constituent of the gold-bearing veins. Occurs with light yellow sphalerite disseminated through auriferous quartz in the Treasure mine, Quartzburg district; also in the Moore Hill and Bondurant mines.

Mono County: This is one of the silver-lead counties and argentiferous galena forms important bodies of ore. It is very common in the Bodie, Benton and Lundy districts and at the claims on the Sweetwater Range.

Monterey County: Small veins of argentiferous galena occurred in the old Alisal mine on El Rancho Alisal, about eight miles southeast of Salinas.

Nevada County: Found in the Meadow Lake and other mining districts of the county. Mentioned by Lindgren[6] as one of the minerals of the mines at Grass Valley and Nevada City.

Orange County: Argentiferous galena occurs near Elsinore and in the Silverado district; at the Blue Light mine, Santiago Canyon.

Placer County: In the Ophir mining district at several of the mines; also in the mining districts: Last Chance, Weimar, Michigan Bluff, Butcher Ranch, Dutch Flat, Canada Hill, Deadwood, Rock Creek.

Plumas County: Occurs in the Meadow Valley and Light's Canyon districts. At the Plumas Eureka mine; in the Butte Bar mine; with gold at Granite Basin; on Feather River a few miles above Quincy.

Riverside County: Found in the Free Coinage mine, the Steele mine and Gold Galena mine. Massive pieces and cubes of galena are associated with the garnet, quartz, sphalerite, pyrite and chalcopyrite at Crestmore.

Sacramento County: At Michigan Bar with sphalerite and pyrite, Hanks[6].

San Bernardino County: Argentiferous galena with lead carbonate was common in several of the silver districts of the county. Common in the Silver Mountain, Silver Reef, and to some extent in the Calico

and Barstow districts. Occurs with linarite, anglesite, cerussite and smithsonite in a dolomitic limestone at the Ibex mine, Black Mountains, six miles north of Saratoga Springs.

San Diego County: Small body in mica schist north of Valley Center.

Shasta County: It is present although not in abundance at most of the copper mines. Common in veins in slate in Weaverville Quadrangle.

Sierra County: In the Pride, Ironsides, Phoenix, Sierra Buttes, Willowby, Alhambra, Bullion, Four Hills, Gold Canyon, Black Jack Alaska, Kanaka, Nixon and other mines.

Siskiyou County: Occurs in deposits near Callahan, carrying some silver. Also at Seiad Valley, Siskiyou mine; Hunter mine; near Yreka; altered to anglesite and cerussite at Happy Camp.

Tehama County: On Cow Creek, Hanks[6].

Trinity County: Reported from Dobbyn Creek near Grizzly Creek.

Tulare County: Prominent in the Mineral King district.

Tuolumne County: At the Soulsby mine, and to some extent with pyrite and sphalerite in the mines on Quartz Mountain and Whiskey Hill. Also at Black Oak mine, Mt. Dana mine, Santa Maria mine, Porto Fino mine, Platt mine, Mary Ellen mine, Keltz mine, Rising Sun mine, Golden Treasure mine, Juliana Bar mine, Star mine, Seminole mine, Providence mine, Carlotta mine, Gem mine, Sonnet mine, Experimental mine.

Ventura County: Occurs with pyrite in the Long Dave mine, near Stauffer.

30. CHALCOCITE—Copper Glance—Redruthite.

Sulphide of copper, Cu_2S.

Orthorhombic. Crystals with deeply striated faces. Generally compact massive. Color dark lead-gray to black. Streak black. Metallic luster. H=2.5—3; G=5.70.

Chalcocite is easily reduced to metallic copper on charcoal. Dissolved in nitric acid and adding ammonia produces a beautiful blue solution. Some reddish ferric hydrate is apt to be precipitated as an impurity.

Massive specimens of the dark gray chalcocite are common in many of the copper claims of the State, but large bodies of this valuable copper mineral are rare. The mineral is formed in the lower levels through the secondary enrichment of the copper-iron sulphides by solutions charged with copper obtained from the upper zones of oxidation. Bornite and chalcopyrite are often intermixed with the chalcocite, and malachite commonly coats the surfaces of specimens.

Alpine County: Probably the first copper claim in the State was the Uncle Billy Roger's claim in Hope Valley, in the northwestern corner of the county. The claim was described as a chimney-shaped deposit in a garnet rock which carried some chalcopyrite, pyrite and chalcocite.

Calaveras County: Small amounts of massive chalcocite have been found in the copper deposits at Campo Seco and Copperopolis. Occurred also on Quail Hill, Silliman[5]. Small amount in quartz at the Excelsior mine, Angels; also in the Telegraph mine, Hog Hill.

Colusa County: Massive at the American mine.

Del Norte County: Massive chalcocite occurred in the Copper Creek, Diamond Creek and Crescent City mines.

El Dorado County: In the old Cosumnes copper mine near Fairplay it was associated with bornite and chalcopyrite. With bornite and chalcopyrite in serpentine at the Boston mine, Latrobe.

Humboldt County: Occurs in the Horse Mountain district. Large masses and disseminated particles in serpentine, in assocation with native copper, malachite and cuprite, occur at the Iron Mt. mine.

Inyo County: There are numerous copper claims in this county and good specimens of the massive chalcocite have come from the Ubehebe Mountains. Also occurs in the Minnietta mine, Lookout Mining district.

Kern County: Associated with chalcopyrite on Mesquite Mountain, near Garlock.

Lake County: Some found on the Langtry Ranch, seven miles south of Middletown.

Lassen County: A fine specimen has come from the Lummis mine.

Los Angeles County: Occurred in the mines at La Soledad Pass.

Madera County: Found in the old Buchanan mine.

Mariposa County: Occurred in small amounts in some of the claims near Coulterville. In the Comet mine, Pocahontas mine and at Hornitos.

Napa County: Associated with covellite and malachite in the Jumper mines.

Nevada County: With cuprite and malachite at the Oro Grande mine, Ciseo.

Placer County: Said to have occurred in the Baker mine near Lincoln. With native copper and cuprite at Meadow Lake.

Plumas County: Rich copper ore consisting of chalcocite and bornite is found in the Gennessee Valley and Light's Canyon districts. Chalcocite occurs at the Engels mine as a replacement of bornite.

Riverside County: Observed at the Mt. King mine. A little chalcocite is present with other sulphides in the limestone at Crestmore.

San Benito County: Small grains of chalcocite occur in the natrolite with the benitoite of this county, Louderback[2].

San Bernardino County: Some of the copper claims in the mountains in the eastern part of the county contain rich masses of copper glance. Good specimens have come from the Silver Prize, Copper World, Francis, Arabella, Florence and Hettie mines. Occurs with bornite at the Francis Copper mine, Kelso district, Providence Mountains. Found

in a quartz porphyry, seven miles south of Ludlow; with bornite, four miles east of Judson; with tenorite, thirty-eight miles east of Mojave.

San Diego County: Found at Potrero in massive specimens.

Shasta County: Some chalcocite has been found in most of the copper mines of the county, but the mineral is not prominent in any of them. Specimens have come from the Mountain Copper, Balaklala, Afterthought, Bully Hill and Copper City mines.

Sierra County: Observed in the Four Hills mine.

Siskiyou County: Found intermixed with molybdenite at the Yellow Butte Copper mine, De Laney; in the Copper King mine; in the Bonanza mine near Honolulu.

Trinity County: In the Copper Queen lode, Carrville district. Occurs with the pyrrhotite mass at Island Mountain.

Tuolumne County: Occurred in the Whiskey Hill mines, Silliman[5].

31. STROMEYERITE.

Sulphide of silver and copper, $(Ag, Cu)_2S$.

Orthorhombic. Generally compact massive. Color and streak dark steel-gray. Metallic luster. H=2.5—3; G=6.15—6.3.

Dissolved in nitric acid, and a few drops of hydrochloric acid added to the solution produces a precipitate of white silver chloride. Ammonia added to solution dissolves this precipitate and the solution turns deep blue.

This mineral has only been found in silver districts where copper is also present. It is formed in the same way as chalcocite and may grade into it.

Alpine County: Believed to be a part of the ore in the Monitor and Mogul districts, associated with galena, sphalerite, pyrite and enargite.

Inyo County: The Silver Queen and other mines of the Panamint Mountains contained the mineral with tetrahedrite and cerargyrite. Found also in the Cerro Gordo and Wild Rose districts.

Riverside County: Probably present in the Homestake copper mine in the Palen Mountains.

San Bernardino County: It occurred as one of the numerous minerals of the Calico district and an analysis of it from the Silver King mine was made by Melville and Lindgren[1].

Ag	Cu	Fe	S	Res = $BaSO_4 + SiO_2$
53.96	28.58	0.26	15.51	1.55=99.86 per cent. Sp. G=6.28

Sierra County: A specimen of copper-silver sulphide stromeyerite came from the Original 16-1 mine, Alleghany.

32. SPHALERITE—Zincblende—Black Jack.

Sulphide of zinc. ZnS.

Isometric, tetrahedral. Imperfect crystals, granular and massive. Cleavage perfect dodecahedral. Color yellow, brown and black. Streak colorless to yellowish brown. Resinous luster. H=3.5—4; G=4.0.

Refractive index: $n=2.47$.

A slight coating, yellowish while hot and whitish when cold, is obtained by intense heating. A few drops of cobalt nitrate added to the assay and intensely heated gives a yellowish green color, which is characteristic of zinc minerals. Gives strong hydrogen sulphide odor when dissolved in hydrochloric acid.

Sphalerite is a very common sulphide and is very prevalent in most of the mining regions. It occurs from clear light brown to very dark brown, almost black masses. Its typical associate is galena, but it is also often intimately mixed with pyrite, chalcopyrite, tetrahedrite, arsenopyrite and lead-silver minerals. In the smelting of zinc-bearing ores few of the smelters have endeavored to save the zinc.

Alpine County: Occurred as one of the minerals in the Rogers claim, Hope Valley.

Calaveras County: Common in the pyrite ore at Campo Seco and Copperopolis. Common in the mines near Murphy with galena. In the Washington mine, Indian Creek; at West Point in the Gold Nugget, Star of the West and other claims, with galena in auriferous quartz. In the Grasshopper, Comet, Jones mines.

El Dorado County: One of the sulphides in the mines at Grizzly Flats, Pilot Hill and other mines of the county. In the Mt. Pleasant, Eagle King, Sun Dog, Flagstaff, Madelena, Humphrey, Grand Victory mines associated with galena.

Fresno County: In the Jumper Claim near Spanish Peak. In the Luakala mine with galena and quartz.

Humboldt County: Found as float on Yager Creek.

Inyo County: Common as an associate with galena in the Darwin, Cerro Gordo and Inyo Mountain mines. Occurs in small amounts with the garnet and scheelite near Bishop.

Kern County: Very fine-grained masses in the Cinderella mine; with pyrite, pyrrhotite and chalcopyrite near Lebec Post Office; in the Urbana mine.

Los Angeles County: With galena and chalcopyrite on Santa Catalina Island.

Madera County: With galena in the McMurray and Homestake mines, Mt. Raymond; in the Gambetta mine, Grub Gulch; at the Fine Gold mine, Railroad Flat; with galena and chalcopyrite at the Nellie and Abbey mines, Hildreth district; in the El Capitan, Advance, De Soto, Matilda and Commoner mines, North Fork district. Occurs on

the North Fork San Joaquin River, and masses of sphalerite with streaks of chalcopyrite occur in the Best Chance mine in the Minaret district.

Mariposa County: Occurs in the mines along the Mother Lode. A light brown tribo-luminescent variety mixed with white barite and gray tetrahedrite, the ore resembling a dark gray schist, was found at the Fitch mine and was described by Eakle[5] and Eakle and Sharwood[1]. The sphalerite emits a peculiar train of light when scratched or rubbed. The material was first put on the market as a radium ore, and later has been ground and sold to the gullible public, under the name "Akoz," as a curative for a great variety of ailments. Light yellow with galena at the Treasure mine, Quartzburg district; dark sphalerite with chalcopyrite on the Chowchilla River; in the Bondurant mine with galena and quartz.

Mono County: Occurs in the Homer, Lundy and Benton districts. Massive black with pyrite occurs at the Bunker Hill mine, Largo district; with galena in the White Mountains east of Benton.

Nevada County: Occurs in many of the gold mines of this county. Prominent in the Meadow Lake district and in the mines of Grass Valley and Nevada City.

Orange County: Occurs with galena in the Blue Light mine, Santiago Canyon.

Placer County: One of the associate minerals in the gold deposit at Ophir. With galena and pyrrhotite in the True Fissure Mine; in the St. Lawrence and Bullion mines.

Plumas County: The mines of the Meadow Valley, Indian Valley and Light's Canyon contain some sphalerite with the other sulphides. Small crystals occur in the fine-grained quartz at Cronsberg; with galena and gold-bearing quartz in Granite Basin and in the Plumas Eureka mine. Small amounts occur with the copper ores at Engels.

Riverside County: Black sphalerite occurs in the vesuvianite-garnet masses at Crestmore, some of it coated with yellow greenockite.

Sacramento County: At Michigan Bar with galena.

San Bernardino County: In this county zincblende is found to some extent with the silver-lead sulphides. Specimens have come from the Silver Reef, Calico, Grapevine and Lava Beds districts. Perfect tetrahedral crystals were found in the Morongo district; also common in the New York mountains.

San Diego County: With pyrrhotite and pyrite near Fallbrook.

Santa Clara County: Small amounts in quartz reported from the Dennis Martin ranch, four miles west of Menlo Park.

Shasta County: Masses of sphalerite occur in the Afterthought and Peck mines and to some extent in the Bully Hill, Copper City, Iron Mountain and other districts of the county.

Sierra County: With galena, chalcopyrite and arsenopyrite in the Alleghany district; in the Sierra Buttes mine, Kanaka mine and in the Nixon Group, American Hill district.

Siskiyou County: Common with galena and chalcopyrite at Callahan. Occurs with pyrite in gold quartz in the Grizzly Gulch mine, Indian Creek, and in the Hunter mine, Cherry Creek.

Trinity County: Small amounts occur with the ore at Island Mountain.

Tulare County: Common in the Mineral King district.

Tuolumne County: Massive at the Soulsby mine and sparingly in the mines along the Mother Lode. At the Starr, Lost Fox, Keltz, Mary Ellen, Platt, Porto Fino, Pine Mountain, Louisiana, Mt. Dana, Santa Maria, Black Oak, Sonnet, Draper, Densmore and Carlotta mines associated with galena and occasionally with pyrrhotite.

33. ALABANDITE.

Sulphide of manganese, MnS.

Isometric. Usually granular massive. Perfect cubic cleavage. Color iron-black to dark brown. Streak green. H=3.5—4; G=4.00.

The roasted mineral gives a manganese bead with borax. Soluble in hydrochloric acid with the evolution of hydrogen sulphide.

Manganese occurs usually as oxides or oxygen compounds, but the sulphide is found occasionally as a vein mineral in metallic sulphide deposits, especially with sulphides of copper.

San Bernardino County: A specimen has come from this county, but the locality is not given.

San Diego County: Specimens have come from this county, perhaps from the Julian district.

34. METACINNABARITE.

Sulphide of mercury, HgS.

Isometric, tetrahedral. Usually massive and amorphous. Color grayish black. Streak black. Metallic luster. H=3; G=7.81.

Vaporizes with invisible fumes and gives a slight sulphur odor. Distinguished from cinnabar by its black color.

The black sulphide of mercury was discovered in 1872 at the old Redington mine, Knoxville, and since its discovery has been found in many of the cinnabar deposits of the State.

Colusa County: Found in the Sulphur Creek district at the Manzanita mine with cinnabar and gold.

Inyo County: Occurred in the Cerro Gordo mine and was analysed by Melville and Lindgren[1].

HgS	$FeS+SiO_2$
95.62	4.38

Lake County: Prominent in the Great Western, Baker and Abbott mines. Also found in the Bradford mine.

Monterey County: With the cinnabar in the Parkfield district.

Napa County: Discovered in the Redington (later Boston) mine. It occurred in black amorphous-like masses and was described as a new mineral by Moore[1]. Good crystals were later found in the same mine which showed the mineral to be isometric instead of amorphous, Penfield[1]. Forms: (111), (211), (322), (975). Analyses of the mineral from this mine were made by Moore[1] and also by Melville and Lindgren[1].

	S	Hg	Fe	SiO_2	
Moore	13.82	85.79	0.39	0.25	=100.25 per cent
		HgS	FeS	SiO_2	
M. and L.		99.48	0.69	0.71	= 99.88 per cent
		98.48	0.94	0.71	=100.13

The old Reed mine contained considerable metacinnabarite. In the Oat Hill mine specimens were found coated with white calomel.

Orange County: Found on the San Joaquin Ranch disseminated through a ferruginous barite; analysed by Genth[8].

Hg	S	Cl	
85.89	13.69	0.32	=99.90 per cent

San Benito County: Large pieces have been found in the New Hope vein of the New Idria mine. Found also at the Picachos mine in black masses, Rogers[5].

San Luis Obispo County: In the Adalaide and Oceanic districts it has been occasionally found.

Santa Clara County: Considerable amounts have been found in the New Almaden and Guadalupe mines. Melville and Lindgren[1] analysed the mineral from the New Almaden mine and described the crystals as hexagonal, with some complex and doubtful forms: (0001), $(05\bar{5}4)$, $(1\bar{1}01)$, $(13\bar{2}2)$, $(50.\bar{5}0.0.1)$, $(48.\overline{46}.\bar{2}.\bar{1})$, $(41.\overline{38}.\bar{3}.\bar{1})$.

Analysis:

S	Hg	Fe	Co	Zn	Mn	$CaCO_3$	SiO_2	Vol. org. matter	
13.68	78.01	0.61	tr.	0.90	0.15	0.71	4.27	0.63	=99.26 per cent

Solano County: Occurred in the Hastings mine.

Sonoma County: Considerable metacinnabarite was found in the Culver-Baer mine, east of Cloverdale.

Yolo County: Found in the California mine, later called Reed mine.

35. CINNABAR.

Sulphide of mercury, HgS.

Hexagonal, rhombohedral. Small crystals common. Also granular massive. Cleavage perfect prismatic. Color cochineal-red. Streak scarlet-red. Adamantine luster. H=2—2.5; G=8.0.

Refractive indices: ϵ=3.202; ω=2.854.

Vaporizes with invisible fumes and yields a slight sulphur odor, but no coating which distinguishes it from realgar. Completely disappears by heating.

Cinnabar was known in the State long prior to the discovery of gold, and the old mine at New Almaden had been in active operation for some time when Lyman[3] described a visit to it in 1848. The most important deposits lie in the Coast Ranges extending from Del Norte County to San Diego County, those in the Sierras being of minor value. The most important counties in the production of quicksilver have been Lake, Napa, Santa Clara and San Benito counties and many flasks of mercury have come from once famous mines which are now idle or exhausted. The deposits in general occur along the contact between serpentine and metamorphic sandstones and shales, and the mineral has been deposited from solfataric waters carrying the sulphide in solution. These solutions have impregnated the sandstones and brecciated masses of opal and chalcedony which have formed in the serpentine through much silicification, leaving seams and pockets of cinnabar. The impregnations have followed flows and intrusions of igneous rock in the immediate neighborhood. Becker[1], Forstner[1] and Bradley[3] have issued general reports on the quicksilver deposits of California.

Alameda County: Streaks of cinnabar occur in a chalcedonic mass in the Cragmont district, North Berkeley.

Calaveras County: A small amount of cinnabar with quartz has been found in the Blue Wing mine, north of Murphy.

Colusa County: Deposits occur on both sides of Sulphur Creek in sandstones and shales, associated with sulphur, bitumen and gold. The Manzanita, Elgin, Empire and Wide Awake mines were former producers. The Manzanita mine was noted for its occurrence of gold with the cinnabar.

Contra Costa County: A deposit was found on the eastern slope of the north peak of Mt. Diablo in serpentine.

Del Norte County: Cinnabar is found in the northern part of the county in the Diamond Creek district.

El Dorado County: The Bernard or old Amador quicksilver mine has produced some of the mineral. The mine is located on Fanny Creek, two miles west of Nashville and about eight miles from Shingle Springs, in slates and quartzites.

Fresno County: Cinnabar claims exist in the Little Panoche district on the Gabilan Range and on Cantua Creek. The Mexican mine, about nine miles southeast of New Idria in sandstones, was an early producer.

Glenn County: The mineral has been reported on the Nye Ranch, southwest of Fruto, and on the Turner Ranch, west of Elk Creek.

Humboldt County: A small deposit occurs near Orleans Bar.

Inyo County: Small amounts of cinnabar occurred at the Cerro Gordo mines. Also observed at the Chloride Cliff mine in the Funeral Mountains west of Rhyolite.

Kern County: The Cuddeback cinnabar mine, three miles from Woodford, contains cinnabar in a porous porphyritic rhyolite. Some cinnabar has been observed about 2½ miles west of Cinco and twenty miles from Mojave.

Kings County: Small deposits of the mineral exist on Table Mountain in the southern part of the county, and the Kings mine has native mercury associated with the cinnabar. The mineral occurs in serpentine, shale and metamorphosed sandstone.

Lake County: The important and interesting deposit of cinnabar at Sulphur Bank on the shore of Clear Lake has been described at length by Becker[1] and by Le Conte and Rising[1]. Cinnabar is at present in process of formation in the porous disintegrated basalt which outcrops on the lake. They are characteristically long hexagonal prisms capped by the low rhombohedron $(20\bar{2}3)$. Melville and Lindgren[1] gave the forms $(30\bar{3}4)$ and $(03\bar{3}4)$. The Great Western, Baker, Helen, Wall Street and Mirabel mines, all situated a few miles from Middletowns, were famous producers. Quicksilver was once the leading mineral output of the county, but at present little cinnabar is mined.

Marin County: Streaks of cinnabar have been observed in the rock near Point Reyes, but no deposits are known.

Mariposa County: Crystals of cinnabar are said to have occurred near Coulterville associated with gold, in a quartz ledge on the Merced River.

Mendocino County: A small deposit at the Occident mine, seven miles southwest of Hopland.

Merced County: Small deposits occur on the dividing line of San Benito County.

Modoc County: A deposit occurs 3½ miles southeast of Willow Ranch station, close to the county road. It has also been reported twenty-five miles southeast of Cedarville.

Mono County: Small amounts of cinnabar have been found about five miles northeast of Bodie. Cinnabar occurs with calcite and some native mercury five miles northeast of Bodie.

Monterey County: Some of the deposits on Table Mountain near Parkfield are in this county. The Patriquin or Parkfield mine has been the chief producer.

Napa County: This county has long been an important producer of mercury, the mine at Oat Hill being among the best known in active operation. The cinnabar is found impregnating unaltered sandstone. The abandoned old Redington or Boston mine at Knoxville is famous for the rare and new minerals found with the cinnabar. Much of the cinnabar of this region impregnates shattered chalcedony masses in the serpentine, as at the Manhattan mine, and some impregnates the serpentine. Crystals from the Boston mine, according to Melville and Lindgren[1], have the forms $(04\bar{4}5)$ and $(10\bar{1}0)$. Deposits of the Pope Valley have also been important. Cinnabar was the leading mineral of the county, the Oat Hill mine being the chief producer.

Nevada County: Found in association with gold at Grass Valley, W. P. Blake[9], Lindgren[6]. Occurs scattered through quartzose and dolomite gangue on contact of serpentine and quartzite on Nickerson Ranch, in southern part of county.

Orange County: A small deposit on San Joaquin Ranch.

San Benito County: The mines in the New Idria district, in the southern part of the county, have been the most productive in the State. The cinnabar solutions have impregnated the sandstones and to some extent the serpentines near the contact of the two and also as stockwerks in slate. The New Idria mine is the most important of the district. Smaller deposits of the mineral also occur near the center of the county and in the extreme northeastern part of the county. Melville and Lindgren[1] describe crystals from the New Idria mine with the forms: (0001), $(02\bar{2}3)$, $(01\bar{1}2)$, $(01\bar{1}1)$, $(20\bar{2}3)$, $(10\bar{1}2)$, $(10\bar{1}0)$, $(6.4.\bar{10}.25)$, $(5.2.\bar{7}.18)$, $(105.60.\bar{165}.407)$, $(63.27.\bar{90}.230)$, $(40.15.\bar{55}.143)$, $(26.12.\bar{38}.95)$. It occurred with stibnite at the French and Florence mines.

San Bernardino County: Deposits exist nine miles northeast of Danby in a breccia. The mineral occurs as inclusions in bluish gray chalcedony in the southern end of Death Valley, fifteen miles northeast of Lead Pipe Springs and forty-five miles north of east from Johannesburg, and colors the chalcedony with reddish blotches and streaks, forming the gem stone known as "myrickite." It has also been found associated with wolframite in the Clark Mountains near Ivanpah. Some cinnabar was also found on City Creek, six miles from San Bernardino.

San Francisco County: Small streaks of cinnabar occur on Twin Peaks.

San Luis Obispo County: The productive mines occur in the Santa Lucia Range, and comprise several districts of which the Oceanic and Adelaide are the most important. The ore impregnates the Fran-

ciscan sandstones and shales and also chalcedonic masses in the serpentine. There are numerous other small deposits in outlying districts.

San Mateo County: Some cinnabar occurred on the Corte de Madera Rancho near Searsville, west of Palo Alto. Small stringers of cinnabar occur in the serpentine just east of San Mateo.

Santa Barbara County: Some cinnabar occurs in the Santa Ynez Range and near the Acachuma Creek. The Acachuma, Los Prietos and Santa Rosa mines have produced some quicksilver.

Santa Clara County: The New Almaden mine is the oldest quicksilver mine in the State. It has been a famous producer and is still being worked. The cinnabar of the district occurs impregnating in streaks the opal-like masses of silica formed by the alteration of the serpentine. Melville and Lindgren[1] described crystals from the mine with forms: (0001), $(01\bar{1}2)$, $(02\bar{2}3)$, $(02\bar{2}1)$, $(10\bar{1}0)$, $(0.14.\bar{1}4.5)$. The Guadalupe, Senator, and other mines of this locality, have also been important producers of the metal.

Shasta County: Some cinnabar is found about thirty miles northeast of Redding, and at the Clover Creek mine.

Siskiyou County: Deposits occur near Oak Bar, which have been worked slightly.

Solano County: The old St. John mine, in a basin between Mount Luffman and Mount St. John, about six miles northeast of Vallejo, was a good producer in the early days of cinnabar mining. The mineral was disseminated in metamorphic dikes.

Sonoma County: Most of the mines which were once productive occur in the Mayacmas district, along the Mayacmas range. This region has been the scene of great volcanic activity and the cinnabar has followed these eruptions and impregnated the sandstones, serpentines and metamorphosed sedimentaries which lie on the flanks of the range. Cinnabar in fine crystals occurs with native mercury and metacinnabarite in the Culver-Baer mine. In the Great Eastern mine a black bitumen corresponding to grahamite occurred with the ore, Bradley[3]. Native mercury is quite prominent in the New Sonoma mine in the Pine Flat district, about sixteen miles northeast of Healdsburg.

Stanislaus County: The cinnabar deposits occur on Red Mountain on the border of Santa Clara County.

Trinity County: The old Altoona and other claims in the northern part of the county, near Cinnabar and Carrville, were once productive.

Tuolumne County: Small crystals and grains of cinnabar occur at Marsh's Flats and on the slope of the ridge east of Horseshoe Bend.

Yolo County: The deposits of this county are in the continuation of the Knoxville district. The Reed mine, originally called the California mine, was the most noted. Much metacinnabarite was associated.

36. GREENOCKITE.

Sulphide of cadmium, CdS.

Hexagonal. Generally as thin coatings. Color lemon-yellow. Resinous luster. H=3 — 3.5; G=4.9 — 5.0.

Refractive indices: $_{\epsilon}$=2.529; $_{\omega}$=2.506.

Mixed with sodium carbonate and heated on charcoal, a coating is obtained which is reddish-brown near the assay and yellow beyond.

A very rare mineral found coating sphalerite occasionally.

It is usually present in zinc sulphide ores and the metallic cadmium output comes from zinc ores.

Mono County: Thin coatings of yellow greenockite occur on magnetite and sphalerite near Topaz.

Riverside County: Thin coatings of yellow cadmium sulphide were found on sphalerite in the limestone quarry at Crestmore.

Shasta County: Cadmium as greenockite occurs in the copper-zinc ores of this county and the Mammoth Copper Company recovers it in their electrolytic zinc plant.

37. COVELLITE—Blue Copper.

Sulphide of copper, CuS.

Hexagonal. Commonly massive. Cleavage basal. Color indigo-blue. Streak grayish black. Metallic luster. H=1.5 — 2; G=4.59 — 4.63.

Refractive index: $_{\omega}$=1.45.

Gives a stronger oder of sulphur than is obtained from chalcocite, otherwise the reactions are the same. Distinguished by color.

Covellite is a much rarer form of copper sulphide than chalcocite and it has only been found as an occasional specimen. It is usually assoeiated with bornite, chalcocite or chalcopyrite.

Calaveras County: Specimens have been found at the Satellite mine near Campo Seco.

El Dorado County: With chalcopyrite in the Rose Kimberley and Bonesett mines.

Humboldt County: Some covellite has been found on Horse Mountain.

Inyo County: Specimens have come from the Ubehebe Mountains.

Madera County: Found at the old Pocahontas mine.

Mariposa County: Small amounts have been found in the Copper Queen mine, near Mariposa.

Napa County: Associated with chalcocite and malachite at the Juniper mine.

Plumas County: Occurs as a marginal replacement of bornite and chalcopyrite at Engels.

Shasta County: Some covellite occurs in the Balaklala mine, and at the Bully Hill mine as an alteration of chalcopyrite.

Sierra County: At the Black Jack mine, Kanaka Creek.

Siskiyou County: Occurs associated with bornite and chalcopyrite at the Copper King mine, Blue Ledge mining district.

38. MILLERITE—Capillary Pyrites.

Sulphide of nickel, NiS.

Hexagonal, rhombohedral. Usually in long slender needles and hair-like tufts. Cleavage perfect prismatic. Color brass-yellow. Streak greenish black. Metallic luster. H=3—3.5; G=5.65.

Roasted on charcoal, it yields a slight odor of sulphur and leaves a magnetic residue. The roasted residue fused in a bead of borax, will give a brown bead, which becomes gray and cloudy, when reduced. Produces a blue solution like copper when dissolved in nitric acid and ammonia added. The borax bead of copper is blue.

Nickel minerals are quite rare in the State and their occurrence has been limited to the discovery of occasional specimens. Some needles of millerite have been found in the cinnabar districts, and rarely with gold.

Calaveras County: Long divergent prisms were found in white albite at the Stanislaus mine on Carson Hill, which Jackson[3] thought to be elongated cubes of pyrite.

Humboldt County: Specimens of serpentine from this county occasionally contain needles of millerite.

Napa County: Small coatings of capillary millerite were found with cinnabar at the Andalusia mine near Knoxville; also at the Oat Hill mine and in Pope Valley. Specimens of serpentine have come from Beryessa Valley containing needles of millerite.

Placer County: Found with arsenopyrite near Ciseo, Hanks[6].

Plumas County: Millerite as coatings occurred in the Pocahontas mine, Mount Meadow district.

39. TROILITE.

Monosulphide of iron, FeS.

Massive. Compact granular. Color light grayish brown. Speedily tarnishes to bronze-brown. Metallic luster. H=3.5—4.5; G=4.7. Non-magnetic.

Fuses to a black magnetic mass. Easily soluble in dilute sulphuric acid and generates strong hydrogen sulphide fumes and odor.

The monosulphide has been found heretofore only in meteorites. Its easy solubility in sulphuric acid distinguishes it from pyrrhotite.

Del Norte County: Found massive in a sheared zone of serpentine, having magnetite included, in a copper claim in the northern part of

the county, northeast of Crescent City. The mineral was analysed and described by Eakle. Analyses of the soluble portion gave:

	Fe	S
1.	58.78	33.62
2.	62.70	35.40

It contains inclusions of magnetite from which it has probably been derived.

40. PYRRHOTITE—Magnetic Pyrites.

Sulphide of iron, Fe_nS_{n+1}.

Hexagonal. Crystals rare. Commonly massive, either granular or compact. Color bronze-brown. Streak grayish black. Metallic luster. Usually slightly magnetic. H=3.5—4.5; G=4.58—4.64.

Usually magnetic cold, but becomes stronger when heated. Slight sulphur odor. Its bronze color and magnetism distinguish it.

The bronze-brown pyrrhotite is often associated with pyrite and sometimes is found in large lenticular masses. It is a common sulphide in gold and copper districts, although generally in small amounts. Masses of it occur in serpentine and in pegmatite veins. It is sometimes nickeliferous.

Calaveras County: Occasionally found with the pyrite at Campo Seco, Copperopolis and at West Point.

Del Norte County: The copper claims in the northern part of the county on Diamond Creek, Copper Creek and Shelly Creek contain pyrrhotite with chalcopyrite. With chalcopyrite and pyrite in the Angora mine, Preston Peak and at French Hill.

El Dorado County: With sphalerite and chalcopyrite in auriferous quartz at the Madalena mine, near Diamond Springs; massive with chalcopyrite at the Noonday mine. In large masses with chalcopyrite and pyrite at the Alabaster mine, Pilot Hill.

Fresno County: Large bodies are said to occur on the Fresno Copper Company's property.

Humboldt County: Bodies are said to exist on Elk Creek.

Inyo County: Occurs with chalcopyrite and pyrite at Marble Canyon.

Lake County: Found on the Langtry Ranch, seven miles south of Middletown.

Madera County: Found in the old Buchanan mine, Turner[4]. Intimate mixtures of pyrrhotite, sphalerite, pyrite and chalcopyrite occur in the Mt. Raymond district. Also in the Minaret district massive containing thin seams of chalcopyrite in chlorite and actinolite at the Heiskell mine. A large body about twelve miles northeast of Madera, said to carry several per cent of cobalt and nickel.

Marin County: Tabular crystals have been found on Mount Tamalpais.

Mariposa County: Thick bodies occur in the Green Mountain mine. The mineral is common as one of the sulphides of the gold mines.

Mono County: Common in quartz at the Tioga mine, Turner[2].

Nevada County: Found in the mines of Grass Valley and Nevada City, Lindgren[6]. Also in the Meadow Lake district, Lindgren[5]. Massive at the Yuba Mine, Washington district; also at Spenceville.

Placer County: One of the sulphides of the Ophir mine, Lindgren[4]. With galena and sphalerite in quartz at the True Fissure mine, Devils Peak Mountain.

Plumas County: Occurs in masses between sandstone and serpentine about 1½ miles south of Taylorsville; intimately mixed with chalcopyrite at the Reward and Beckwith mines.

San Diego County: A large body of nickel-bearing pyrrhotite occurs at the Friday copper mine, Julian district, on contact of gabbro and fine-grained mica-schist. It has pyrite, chalcopyrite and polydymite associated. Occurs also near Fallbrook.

Shasta County: Found with the pyrite at some of the copper mines and noticed at the Black Diamond copper mine and Sutro mines; also carrying nickel on the Jennings property near Hirtz Mountain.

Sierra County: With chalcopyrite at the Lost Cabin prospect.

Siskiyou County: Prominent with chalcopyrite at Callahan. Said to be nickeliferous at the Hummer mine. With chalcopyrite at the Bonanza mine, near Honolulu; at the Carlson mine, Dutch Creek; with galena in quartz at the Siskiyou mine, head of White Gulch.

Trinity County: Near Otto Rest specimens have been found.

Tuolumne County: In gneiss on north fork of Beaver River, Turner[8]. Occurs with sphalerite and galena at the Soulsby mine; in quartz with galena and sphalerite at the Montgomery, Cherokee, Carlotta, Densmore, Draper and Louisiana mines.

41. POLYDYMITE.

Sulphide of nickel, Ni_4S_5.

Isometric. Crystals and massive. Color steel gray. Metallic luster. H=4.5; G=4.51—4.81.

Soluble in nitric acid, giving green solution, which turns blue on the addition of ammonia. Becomes magnetic on heating and gives off sulphur odor.

The presence of nickel has been detected in some of our pyrrhotites and it may be in the form of a nickel sulphide such as polydymite or pentlandite.

San Diego County: It is believed that the nickel mineral included in the pyrrhotite at the Friday mine, Julian district, is polydymite.

42. BORNITE—Erubescite—Peacock Ore.

Sulphide of copper and iron, Cu_3FeS_3.

Isometric. Crystals very rare. Generally compact massive. Color reddish brown, generally tarnished to iridescent colors. Streak grayish black. Metallic luster. H=3; G=4.9—5.4.

Reduced on charcoal with sodium carbonate, it yields globules of metallic copper and a magnetic residue. Dissolved in nitric acid and ammonia added, much ferric hydrate is precipitated, while the solution becomes blue.

Bornite is generally associated with chalcocite and chalcopyrite, and is frequently found in small masses in many of the copper districts. It is sometimes formed along contact zones with garnet, epidote, vesuvianite and other contact minerals. The reddish brown color and characteristic tarnish to peacock colors readily distinguishes bornite from grayish black chalcocite and brass-yellow chalcopyrite.

Calaveras County: Small masses have been found at Campo Seco and Copperopolis.

Del Norte County: Common in the mines at the head of Copper Creek. Found with enargite at French Hill.

El Dorado County: At Slug Gulch with chalcopyrite and massive green epidote. In the old Cosumnes copper mine near Fairplay, massive bornite occurred in coarse pegmatite of orthoclase, hornblende, epidote, garnet and molybdenite. Found at Georgetown with massive garnet. Small amounts found in the Alabaster Cave mine near Newhall, with chalcopyrite, azurite and malachite.

Fresno County: Occurs with magnetite and free gold in the Uncle Sam mine, Tehipite Dome.

Inyo County: Found in some of the mines of the Inyo and Ubehebe Mountains.

Lassen County: Bornite occurs disseminated in a pegmatite vein three miles west of Buntingville.

Los Angeles County: Found in the Meadow Valley district with fine crystals of garnet.

Mono County: Occurred in the Tioga mine and in the Benton district.

Plumas County: Massive bornite is a common form of copper in Light's Canyon, Genessee Valley and Indian Valley. The chief copper mineral of the county. Brilliant peacock ore occurs in the Engels mine and Duncan mine.

Riverside County. A small amount of this sulphide was found with the metamorphic silicates at Crestmore.

San Bernardino County: Bornite occurs at the Tiptop mine, Lava Beds district. Found with chalcocite in the Francis Copper mine, Kelso district, Providence Mountains.

Santa Clara County: Near Lexington, Hanks[6].

Shasta County: Bornite is occasionally found in the copper mines of this county and specimens have come from Bully Hill, Copper City, Afterthought and Iron Mountain.

Trinity County: Occurs with pyrrhotite at Island Mountain.

43. CUBANITE.

Sulphide of copper and iron, $CuFe_2S_4$.

Isometric. Generally massive. Color bronze-yellow. Streak black. Metallic luster. H=4; G=4.

Gives similar reactions to chalcopyrite.

Cubanite is a rare mineral and it needs careful analyses to substantiate its occurrence.

El Dorado County: Specimens have come from some locality in this county.

San Luis Obispo County: A large mass of this mineral was found on Santa Rosa Creek near San Simeon, Hanks[6]. The specimens have a bronze-yellow color and are compact massive.

44. CHALCOPYRITE—Copper Pyrites.

Sulphide of copper and iron, $CuFeS_2$.

Tetragonal. Generally massive. Color deep brass-yellow, often with iridescent tarnish. Streak greenish black. Metallic luster. H=3.5—4; G=4.1—4.3.

Fusible and soluble. Ammonia added to a nitric acid solution precipitates reddish ferric hydrate and turns solution blue. Becomes magnetic after roasting and small globules of copper are obtained by reduction with soda. Distinguished from pyrite by deeper color and presence of copper; from bornite by its brass color, and from gold by its ready solubility in nitric acid.

Chalcopyrite is the commonest of the copper minerals and forms the principal source of copper in the State. The copper deposits are largely bodies of pyrite in which chalcopyrite is intermingled, forming in general low grade copper ore with some gold and silver. The ore bodies usually occur in shear zones and belts of metamorphic rock and their origin has been due to solutions carrying the sulphides and impregnating the crystalline schists, and occasionally the country rock, the impregnations following flows and intrusions of igneous rock. Where conditions have been favorable the pyrite has become segregated into large masses with often more or less lenticular shape. Deposits along the contact between limestone and igneous rock are common. The common associated minerals with the pyrite and chalcopyrite are galena and sphalerite and occasionally stibnite, bismuthinite and tetrahedrite. Besides quartz, calcite and barite are often present as gangue minerals. Most of the deposits have a gossan capping of earthy limonite and

hematite resulting from the oxidation of the iron sulphides. Practically all of the large bodies of pyrite in the State carry some chalcopyrite, but those in Shasta and Calaveras counties are at present the most important in the production of copper. Chalcopyrite in small patches and seams has a wide distribution and in consequence of its alteration green stains and coatings of copper carbonate are very common. A general report on the copper resources of the State has been given in Bull. 50, California State Mining Bureau, and some of the data regarding localities is incorporated below.

Alameda County: A body of pyrite containing a small amount of chalcopyrite is mined at Leona Heights, East Oakland, for sulphuric acid. The ore lies between serpentine and altered volcanic rock and the alteration minerals have been described by Schaller[1].

Alpine County: The oldest copper claim in the State was the Uncle Billy Rogers claim in Hope Valley. This claim located in 1855 consisted of chalcopyrite, pyrite and bornite in a chimney-shaped deposit in garnet rock. Some chalcopyrite occurs with the pyrite and enargite in the Mogul district.

Amador County: In the foothills in the western part of the county there is a belt of hornblende and chlorite schists which contain frequent lenticular masses of pyrite with chalcopyrite and many claims are located along the belt. The old Newton mine near Ranlett, claims near Jackson and those of Copper Hill are well known.

Butte County: Occurs near Bangor. Occurs with quartz, chalcocite, chalcopyrite and gold on Berry Creek.

Calaveras County: The belt of schists in the western part of the county contain important deposits and the mines at Copperopolis and at Campo Seco are still important producers of copper. Copper is one of the chief mineral products of the county and chalcopyrite is the principal mineral. Some of the mines in which the mineral occurs are: Sheridan mine, one-half mile below Robinson Ferry; Pattee mine, Valley Springs; King mine in quartz; Hoosier mine in quartz; Calaveras Chief mine; Blazing Star and Lockwood mines, West Point; Telegraph mine, Hog Hill, with chalcocite, melaconite, covellite, malachite, azurite and native copper; with chalcocite at the Excelsior mine, Angels; Napoleon, Union and Satellite mines, Copperopolis; Keystone mine; Quail Hill.

Colusa County: Occurs two miles from Phelps Springs, Stony Creek.

Contra Costa County: Occurs with pyrite in quartz on Eagle Peak, Mt. Diablo.

Del Norte County: Deposits of chalcopyrite with pyrite and pyrrhotite occur in the serpentine area of the northern portion of the county

near Smith River and its tributaries. Low Divide, Diamond Creek and Shelly Creek are some localities.

El Dorado County: There are numerous small deposits of the mineral in scattered areas in the county, but none of great importance. The mineral is found near Diamond Springs, near Georgetown and at Pilot Hill in the northwestern part of the county. Good specimens of chalcopyrite with bornite, molybdenite, garnet, epidote and axinite have come from the old Cosumnes copper mine on the Amador County line. Occurs in small amounts in a hornblende schist near Rescue; with pyrrhotite and pyrite at the Noonday mine; in gold-bearing quartz with galena at the Rose Kimberly mine; at the Cambrian mine, thirteen miles northwest of Placerville with malachite, azurite and native copper; in an amphibole schist at the Copper Lead mine, Martinos Creek; with sphalerite and pyrrhotite in gold quartz at the Madalena mine, near Diamond Springs; at the Pyramid and Bonesett mine near Shingle Springs; with galena, magnetite, calcite, quartz and garnet in the Lilyoma mine and in the Pioneer mine, Pilot Hill; with bornite, azurite and malachite at the Alabaster Cave mine, Pilot Hill; at the Boston and Yetter mines, Latrobe; in the Blue Ledge, Bowlder and Oest mines. Occurs with chalcocite in serpentine at the Boston mine, Latrobe.

Fresno County: Chalcopyrite occurs with pyrrhotite at the Fresno copper mines, with pyrite at the Copper King mine, and in the gold district of the northeast part of the county.

Humboldt County: Deposits occur on the east slope of Horse Mountain with chalcocite, native copper and cuprite. In small amounts near Trinidad, on the sea coast; sparingly on Red Cap Creek.

Imperial County: In the extreme eastern part of the county the copper claims near Ogilby, Hedges and in the Picacho district contain some chalcopyrite with oxidized ores.

Inyo County: Chalcopyrite occurs near Darwin on contact between granite and limestone and in the Ubehebe Mountains with chalcocite. Occurs with galena, cerussite and native copper in limestone at Chloride Cliff, Grapevine Range; at contact of limestone and diorite at Gold Belt in the Panamints; with pyrrhotite, bornite and pyrite in Marble Canyon, twenty-five miles east of Big Pine; in garnet rock in Mazurka Canyon; banded masses with galena at the Custer mine; with gold quartz at the Golden Treasure mine; in the Argus Range; with galena and pyrite five miles southeast of Keeler.

Kern County: Chalcopyrite with pyrite occurs in the gold mines of the eastern part of the county near Randsburg and Garlock. Occurs with sphalerite and pyrrhotite near Lebec. Occurs with wolframite near Woody.

Lake County: Associated with pyrrhotite on the Langtry Ranch, seven miles south of Middletown.

Los Angeles County: Intimately mixed with pyrrhotite near San Fernando; with pyrite and malachite, two miles north of Camp Rincon, San Gabriel Canyon.

Madera County: The belt of schists carrying the copper and iron sulphides extend across the county and there are numerous small claims. Found in small masses in the Green Mountains, at the old Buchanan mine, at the Ne Plus Ultra and other claims near Daulton. Occurs as thin seams in massive pyrrhotite in chlorite and actinolite at the Heiskell mine; with sphalerite in quartz in the Nellie mine, Hildreth; in intimate mixture with sphalerite and pyrrhotite at the Matilda and Best Chance mines, Minaret district.

Marin County: Small deposits of pyrite mixed with chalcopyrite occur in the schists between Mount Tamalpais and Bolinas Bay. A small deposit occurred about one mile east of Woodville and north of Bolinas.

Mariposa County: Chalcopyrite is present to some extent in the gold mines of the county. Several small bodies of the sulphides occur in the schists and altered diabases on the western border, but of little importance. The Green Mountains and other mines on the south border near Donovan, the old Pocahontas mine near Lewis, the Copper Hill mines in Indian Gulch, the old Beretta mines and other claims near the Merced River, all contain massive chalcopyrite with auriferous pyrite. Occurs with tetrahedrite at the Bunker Hill mine; with pyrite and arsenopyrite at Hornitos; at the Peterson, Comet, White Rock and Donaway mines.

Mendocino County: Occurs with some malachite in small quartz veins at the Eden Valley mine and in the Red Mountain district.

Nevada County: At Spenceville, Mineral Hill, Pine Hill, Iron Mountain, French Corral and North San Juan chalcopyrite claims have been worked. Good masses of pure chalcopyrite also are found in the Meadow Lake district. Occurs with pyrite in quartz veins in the schists extending from Birchville northward to Bullard's Bar, Sierra County.

Placer County: Near Auburn, Newcastle, Valley View and at Dairy Farm good deposits of pyrite with some chalcopyrite occur.

Plumas County: Deposits of good chalcopyrite with bornite and chalcocite are found in Genessee Valley near Flournoy, in Indian Valley near Taylorsville and in Moonlight and Light's canyons about twelve miles north of Taylorsville. Associated with covellite, chalcocite, malachite, pyrite and quartz in schists one mile from Gibsonville. Common in mines at Butte Bar. Bodies fifteen feet thick occur at the con-

tact of granodiorite with limestone and slate at the Cosmopolitan mine, Genessee district. Associated with epidote, garnet and bornite at the Duncan mine.

Riverside County: The copper deposits lie mostly in the eastern part of the county in the Palen, McCoy and other mountains. Common in auriferous quartz veins of the Monte Negro district. Brassy chalcopyrite occurs with pyrite and galena at the Crestmore limestone quarry.

San Benito County. Occurs in small amounts on Lewis Creek.

San Bernardino County: There are numerous gold-copper claims in the county, especially in the mountains of the eastern part. Some chalcopyrite occurs with oxidized copper ores in the Clarke Mountains, New York Mountains, near Ivanpah, Manvel, Vontrigger, Sunrise, Needles, on Mount Whipple, Monument Mountain, Turtle Mountain and Providence Mountains. The mineral is also found in the Lava Beds district, in the Oro Grande district and in the Morrow district north of Barstow. Occurs in limestone at the Three States mine, Silver Lake district. Large specimens have come from the Kingston Range. Found with specular hematite, quartz and pyrite in the Bullion district. Occurs with galena, argentite and pyrite in the Goldstone district. In a quartz vein with sphalerite, galena and wolframite at the Sagamore mine, New York Mountains.

San Diego County: Masses of chalcopyrite occur in the Encinitas group of mines, a few miles east of Encinitas and in the Banna mines near Lakeside. Some is found in the Julian district. Found in gold-bearing quartz veins on Barker Mountain and on the east slope of mountain.

San Luis Obispo County: Observed at Cambria.

Santa Barbara County: Occurs with quartz in shale at several points along the south slope of the San Rafael Mountains, northeast of Los Olivos.

Shasta County: The deposits of this county are the most important and most extensively worked in the State. The ore is pyrite carrying the copper sulphide, and while in general low-grade copper propositions, the immense size of the bodies makes them of great value. The Iron Mountain, or Mountain Copper, Shasta King, Balaklala, Golinsky, Mammoth and other mines on the west side of the Sacramento River, and the Afterthought, Copper City and Bully Hill mines on the east side of the river, have been great producers of copper for some years. The ore bodies in general lie in shear zones in metarhyolite or meta basalt, and sometimes along the contact of the igneous rock and limestone.

Sierra County: Small masses of chalcopyrite with other sulphides occur near Poker Flat, Sierra City and in the Mohawk Valley. At the

Black Jack mine, Kanaka Creek; at Four Hills, Sierra City district; in Alaska mine and Gold Canyon mine, Alleghany district.

Siskiyou County: The Richie mine and claims near Callahan show chalcopyrite. At the Dewey and Oak Hollow mines, Happy Camp; in the Buckeye district; at the Hunter mine, Cherry Creek; massive fine-grained about four miles southeast of Fort Jones; at the Yellow Butte mine, Weed; massive mixed with pyrrhotite and pyrite at the Carlson mine, Dutch Creek; in quartz at the New York Gulch mine, Indian Creek; at the Blue Ledge mine, Elliot district; at the Apex mine, head of Cottonwood Creek; with pyrrhotite in schist on south fork of Salmon River and on Preston Peak; at the Maryland mine, Quartz Valley; at the Bonanza mine, near Honolulu; mixed with pyrrhotite eight miles east of Callahan; at the Doolittle and Gazelle mines.

Sonoma County: Occurs in small crystals with malachite and azurite at the Sonoma Copper mine, one-half mile east of Tyrone; with pyrite on Black Mountain; in the Cornucopia mine, fourteen miles northeast of Cloverdale; in the Grizzly mine, eighten miles northeast of Healdsburg.

Tehama County: Found five miles northwest of Paskenta; with pyrite on the north slope of Tom Hood Mountain, forty miles west of Red Bluff.

Trinity County: Some deposits of the mineral occur in the western part of the county along New River, at the mouth of Rattlesnake Creek and on the Cold Fork of Indian Valley Creek. Primary ore in the Copper Queen and Headlight mines, Carrville district; with pyrite in schists near Ruth; in the quartz of the Gambrinius and Craig gold mines; at the Bear Tooth mine, New River district; near Zenia. Associated with pyrrhotite at Island Mountain.

Tulare County: Chalcopyrite with pyrite is found on the middle fork of Tule River, a few miles east of Porterville and also near Kearsarge Peak.

Tuolumne County: The schist belt carrying the sulphides crosses the county a few miles west of the Mother Lode and several small claims are located along the belt. Masses occur with pyrite in quartz at the Union, Conrad and Society mines, Big Oak Flat; with other sulphides at the Keltz mine, ten miles north of Soulsby; in auriferous quartz at the Black Oak mine, Soulsby; at Chinese Camp; near Rawhide; at the Experimental mine, two miles northwest of Columbia; at the Mann Copper mine, three miles south of Jamestown; at the Golden Gate mine near Sonora; at the Greenstone, San Guisippe, Mount Dana, Platt and Golden Treasure mines.

Yuba County: Occurs in auriferous quartz in the Brownsville district, in the Golden Mary mine; in the Ayer mine, four miles west of Smartsville.

45. MARCASITE—White Pyrites.

Sulphide of iron, FeS_2.

Orthorhombic. Commonly in tabular crystals, stalactites. Also massive and indistinguishable from pyrite. Color pale brass-yellow. Streak brownish black. Metallic luster. H=6—6.5; G=4.85—4.9.

Roasted on charcoal, it gives sulphur odor and yields a magnetic residue. Distinguished from pyrite only by crystal form.

Marcasite can not readily be distinguished from pyrite except when in crystals, so it is often classed as pyrite. It is much rarer in the State than pyrite, and is rather characteristically associated with clays and cinnabar.

Alpine County: Specimens associated with sphalerite have come from some of the mines of the county.

Napa County: Marcasite was the abundant iron sulphide at the old Redington mine, Knoxville, in close association with the cinnabar.

Nevada County: Mentioned as one of the minerals of the Grass Valley mines by Lindgren[6].

Sonoma County: Small but good crystals have come from near Calistoga.

46. PYRITE—Iron Pyrites.

Sulphide of iron, FeS_2.

Isometric. Crystals common; usually cubes, pyritohedrons and octahedrons. Generally compact and granular massive. Color brass-yellow. Streak greenish black. Metallic luster. H=6—6.5; G=5.

Roasted on charcoal, it burns with a blue flame and gives a strong sulphur odor. The residue becomes magnetic. Soluble in nitric acid and reddish ferric hydrate is precipitated by ammonia.

Pyrite is the commonest of the sulphide minerals and is found in all kinds of rock, but is more especially prominent in metamorphic schists, slates and quartzites and in unaltered sandstones. It is commonly found in distinct crystals and in granular masses. Cubes several inches in diameter are frequent in gold districts, but in general the smaller crystals and granular masses are more highly auriferous. It is from pyrite bodies that most of the copper production of the State is obtained, the source of the copper being the intimately intermingled chalcopyrite. All of the localities given for chalcopyrite and many more might be cited for the mineral since it is present in every county. Its oxidation produces limonite and hematite and the gossan of mineral veins is mostly formed by its alteration. Cubes of limonite as pseudomorphs after pyrite are exceedingly common.

Alameda County: Crystals from the Alma mine, Leona Heights, have the forms: (110), (100), (340), (120), (140), (111), (252), (121), (241), (231), Schaller[1].

Calaveras County: Cubes and pyritohedrons occur with the gold on Carson Hill, but the long needles from the Stanislaus mine, described as distorted pyrite crystals by Jackson[3], are millerite. Good cubes are found at Murphy in the Masonia mine.

Colusa County: Hexagonal plates of pyrite occur as pseudomorphs after pyrrhotite at the Sulphur Creek deposit, Genth[7].

Mendocino County: A large deposit carrying chalcopyrite occurs in Anderson Valley.

Riverside County: The common sulphide of iron is present in the Crestmore limestone as grains, cubes and pyritohedrons; some of the crystals are large. Limonite pseudomorphs after the pyrite are common.

Santa Clara County: Crystals from the New Almaden cinnabar mine had the forms: (100) and (470), Jackson [3].

Sonoma County: Large octahedrons have been found on Austin Creek near Healdsburg.

Trinity County: Occurs with pyrrhotite at Island Mountain.

Tuolumne County: Small cubes are common at the Norwegian mine.

OXISULPHIDES.

47. KERMESITE—Red Antimony.

Oxisulphide of antimony, Sb_2S_2O.

Monoclinic. Usually in hair-like tufts. Color cherry-red. Streak brownish red. Metallic to adamantine luster. H=1—1.5; G=4.5.
Refractive indices: $\alpha=2.74$; $\beta>2.72$.
Gives a reaction similar to stibnite.

This is a rare mineral formed by the oxidation of minerals containing antimony, especially stibnite. It is generally in cavities as long cherry-red needles.

Kern County: Fine red needles of kermesite were found on stibnite at the Mojave antimony mine, about fifteen miles north of Mojave.

48. VOLTZITE.

Oxisulphide of zinc, Zn_5S_4O.

Globular and lamellar forms. Color rose-red to brown. Streak brownish red. Vitreous luster. H=4—4.5; G=3.66—3.8.
Refractive index: $\omega=2.03$.
Like sphalerite in its reactions.

A very rare mineral which forms globular and platy reddish brown coatings from the oxidation of zinc sulphide.

San Bernardino County: Specimens have come from some place in this county.

CHAPTER III.

ARSENIDES, SELENIDES, TELLURIDES AND SULPHOSALTS.

Arsenides.
- Cobaltite
- Arsenopyrite
- Niccolite
- Smaltite
- Löllingite
- Leucopyrite

Selenides.
- Tiemannite

Tellurides.
- Tetradymite
- Hessite
- Petzite
- Altaite
- Coloradoite
- Melonite
- Sylvanite
- Calaverite
- Nagyagite

Sulphantimonites.
- Berthierite
- Jamesonite
- Bournonite
- Miargyrite
- Pyrargyrite
- Tetrahedrite
- Geocronite
- Stephanite
- Polybasite

Sulpharsenites.
- Dufrenoysite
- Proustite
- Enargite

ARSENIDES.

49. COBALTITE.

Sulpharsenide of cobalt, CoAsS.

Isometric. Commonly in cubes and pyritohedrons; also massive. Cleavage perfect cubic. Color reddish white. Streak grayish black. Metallic luster. H=5.5; G=6—6.3.

On charcoal it gives sulphur odor and white coating of arsenic oxide when roasted. The residue becomes magnetic. Borax bead of the roasted material is cobalt blue. Ammonia colors a nitric acid solution pink.

Cobalt and nickel compounds are very rare in the State, and only an occasional specimen is found.

Mariposa County: Good crystals were found in the Copper Chieftain mine.

Mono County: Occurred with gold in the Tioga mine, Turner[2].

Nevada County: Small seams of cobaltite with chalcopyrite occur in a schist on Rattlesnake Creek, south of Signal Peak.

Placer County: Found with arsenopyrite in the Metallic mine, near Cisco, and with chalcopyrite about four miles northeast of Alta.

50. ARSENOPYRITE—Mispickel—Arsenical Pyrites.

Sulpharsenide of iron, FeAsS.

Orthorhombic. Common in crystals. Generally compact to granular massive. Color silver white to steel gray. Streak grayish black. Metallic luster. H=5.5—6; G=5.9—6.2.

Copious white volatile fumes of arsenic oxide and a strong garlic odor are obtained when roasted on charcoal. Residue becomes magnetic. Borax bead is yellow to pale green.

Arsenopyrite is a very common vein mineral and is sometimes highly auriferous. The concentrates from most of the mining regions of the State generally contain more or less of it and in some districts arsenopyrite is the chief gold-bearing ore. Most of the arsenic of commerce is obtained from this mineral generally as a by-product in the smelting for gold and silver.

Danaite is a variety containing from four to ten per cent of cobalt.

Amador County: In the New Hope mine, in Quartz Mountain mines, and in the mines between Jackson and Mokelumne Hill, arsenopyrite occurs.

Calaveras County: Near Angels and in the mines along the Mother Lode considerable arsenopyrite has been found high in gold content. Occurs with pyrite in quartz veins cutting amphibole schist, at the Chaparral Hill mine.

Del Norte County: At Monkey Creek.

El Dorado County: Occurred in the Florence mine near Placerville, and also near Georgetown. Auriferous at the Frog Pond mine, one-half mile north of Garden Valley; at the Barnes Eureka mine near Shingle Springs; in the Mt. Pleasant district.

Fresno County: Quite large amounts with pyrite and chalcopyrite in auriferous quartz in the N. W. ¼ Sec. 16, T. 13 S., R. 27 E.

Imperial County: Found in the mines of the Cargo Muchacho district.

Kern County: The Sumner, Confidence, Relief and other old mines near Kernville and Havilah contained auriferous arsenopyrite. Occurred with the gold quartz at the Yellow Aster mine, Randsburg. Good crystallized specimens found at the Long Tom mine; with quartz in the Amalie district; with galena and pyrite in quartz at the Bright Star mine, Piute district.

Madera County: On Iron Mountain in small amounts.

Mariposa County: In mines near Coulterville; danaite with erythrite was found in the Josephine mine, Bear Valley, Turner[4]. With calcite and quartz in the Smith mine, Bear Valley; with magnetite in the Cave mining district; with chalcopyrite and pyrite at Hornitos.

Mono County: Common in the Lundy district carrying gold.

Monterey County: In auriferous quartz at the Oregon mine, Sec. 2, T. 24 S., R. 5 W.

Nevada County: Found in the Betsy mine, Grass Valley and in the Meadow Lake district. Danaite was found in the Meadow Lake district, W. P. Blake[10]. A two-foot ledge was found at the Porcupine mine, Cisco. Fine crystals in schist on Poormon Creek; crystals on quartz at the Delhi mine, Columbia Hill.

Placer County: One of the minerals in the mines of the Ophir district, Lindgren[6]. Observed in the Canada Hill and Dutch Flat districts.

Arsenopyrite containing nickel and cobalt has been found three miles from Cisco.

Plumas County: Large bunches in Pilot Hill gold mine, six miles northwest of Gibsonville. Some has been found in Genessee Valley.

Riverside County: Small crystals about two millimeters long occur in the limestone quarry at Crestmore.

San Bernardino County: Occurs on Baldy Mountain.

San Diego County: Occurs in the Julian district.

Sierra County: The chief gold-bearing mineral at Alleghany and containing a high percentage of gold. In the Golden King mine on Kanaka Creek it is said to have occurred with gold telluride. Common in the mines of the Forest Hill district, the Oriental Osceola Lode, Uncle Sam, Rainbow, Bonanza, Mammoth Springs, Lost Treasure, Kate Hardy, El Dorado mines; in the Eagle and Docile mines, Kanaka Creek; at the Mexican Eley and High Commission mines, Downieville district; at Gold Canyon, three miles from Moore's Flat; at the Kenton, Ironsides and Four Hills mines with chalcopyrite and galena.

Tehama County: Occurs with quartz and pyrite at Sarkenita.

Trinity County: Gold-bearing arsenopyrite occurs in the Craig mine, two miles east of Dedrick; on Lowden's Ranch and Burnt Ranch with gold; near Weaverville.

Tulare County: Found in the Mineral King district.

Tuolumne County: Crystals of arsenopyrite having crystallized gold deposited on them occur at the Alameda mine, Rawhide mining district.

51. NICCOLITE.

Arsenide of nickel. NiAs.

Hexagonal. Usually massive. Brittle. Color pale copper-red. Luster metallic; streak brownish black. H=5—5.5; G=7.33—7.67. Fuses on charcoal to a globule giving off fumes of arsenic. Roasted mineral fused in borax bead gives a brown bead in oxidizing flame and a gray, cloudy bead in reducing flame. Usually contains some cobalt.

Niccolite is often associated with smaltite and both cobalt and nickel reactions are generally obtained. A very rare mineral in the State.

San Diego County: The only nickel mineral named as possibly present in the pyrrhotite of the Friday mine, Julian district, is polydymite, but the ore carries considerable arsenic and cobalt, so there is a strong probability that niccolite and smaltite are both present.

52. SMALTITE—Cobalt Glance.

Arsenide of cobalt, $CoAs_2$.

Isometric. Generally massive. Color tin white. Streak grayish black. Metallic luster. H=5.5 — 6; G=6.4 — 6.6.

Gives a white coating of arsenic trioxide on charcoal. A cobalt blue bead of borax is obtained, using the roasted mineral. The roasted mineral becomes magnetic.

Smaltite usually contains some nickel and it is the more common form of cobalt compound. A few small veins and seams of the mineral have been found in the State but no important deposits.

Lassen County: Specimens of gray smaltite with erythrite and annabergite as alteration products have come from some locality in this county.

Los Angeles County: At the old Kelsey and O. K. mines near San Gabriel Canyon smaltite coated with erythrite occurred with the native silver and argentite.

Napa County: The mineral has been found in thin seams with erythrite in the serpentine rock of the Berryessa Valley.

Nevada County: Occurs in the Meadow Lake district.

San Diego County: Specimens have been received from a locality near the Mexican line.

53. LÖLLINGITE.

Arsenide of iron, $FeAs_2$.

Orthorhombic. Small crystals or granular. Color silver white to light steel-gray. Streak grayish black. Metallic luster. H=5 — 5.5; G= 7 — 7.2.

Similar to arsenopyrite in its reactions except that it gives no sulphur deposit in a closed tube.

This mineral is rare as most of the arsenical iron is arsenopyrite. *Leucopyrite* is a variety with a different proportion of arsenic and iron, Fe_3As_4.

Amador County: Small crystals of löllingite were found in the black slate at the Mayflower mine, Amador City.

Los Angeles County: Specimens of leucopyrite have come from this county, Hanks[6].

SELENIDES.

54. TIEMANNITE.

Selenide of mercury, HgSe.

Isometric, tetrahedral. Generally massive. Color dark lead-gray. Streak black. H=2.5; G=8.30 — 8.47.

Gives the peculiar odor of selenium when heated on charcoal. Reduces easily to metallic globules of mercury.

The selenide is not a common form of mercury but some large masses of it have been found in the cinnabar districts.

Lake County: According to W. P. Blake[9] the mineral occurred in large masses in the vicinity of Clear Lake. Masses of it occurred in the Abbott mine associated with cinnabar and petroleum.

Orange County: Found with cinnabar and metacinnabarite at the San Joaquin Ranch mine.

Santa Clara County: Found with cinnabar at the old Guadalupe mine near New Almaden.

TELLURIDES.

55. TETRADYMITE.

Telluride of bismuth, Bi_2Te_3.

Hexagonal, rhombohedral. Commonly granular. Color steel-gray. H=1.5—2; G=7.2—7.6. Cleavage perfect basal. Metallic luster. Yields a yellow coating on charcoal which becomes bright red on its outer border when fused with the potassium iodide and sulphur flux.

The characteristic reaction for all tellurides is the violet solution obtained by boiling a little of the powdered mineral in a few drops of concentrated sulphuric acid.

This rare telluride is probably present in some of the gold mines where bismuth and tellurium are found in the concentrates, but it has only been identified in a few localities.

Calaveras County: Found with gold in the Melones and in the Morgan mines on Carson Hill, associated with other tellurides of this famous telluride locality, Hanks[6].

Nevada County: Occurred at the old Murchie mine near Nevada City, Hanks[6].

Tuolumne County: Small amounts have been found at the Soulsby mine.

56. HESSITE.

Telluride of silver, Ag_2Te.

Isometric. Generally in distorted octahedrons. Sometimes massive. Color lead-gray to steel-gray. Streak dark gray to black. Metallic luster. H=2.5—3; G=8.31—8.45.

Reduces easily to a metallic button of silver when fused on charcoal, and yields a white coating of telluric oxide. Gives the tellurium reaction like tetradymite.

Hessite generally contains gold and often grades into petzite so the two tellurides are apt to be together in mines. They are the more common forms of tellurium and occur in most mines where gold tellurides are found, often associated with sylvanite or calaverite.

Calaveras County: Hessite was one of the tellurides of the old Stanislaus mine on Carson Hill. It was analysed by Genth[4].

Au	Ag	Pb	Ni	Te	
3.28	46.34	1.65	4.71	44.45	=100.43.
3.22	55.60	--	1.54	(39.64)	

El Dorado County: Found massive as a drift specimen with galena and inclosing gold at Georgetown, W. P. Blake[5]. Reported to occur in Barnes Eureka mine, three miles northeast of Shingle Springs.

Kern County: Has been observed with the silver minerals at the Amalie mine.

Nevada County: A specimen of pyrite, galena and native gold from the Nevada City mine contained some soft gray hessite, Lindgren[6].

Shasta County: Found in the Shearer and Rattler mine, 3 miles from Redding.

Sierra County: Found in the Golden King mine on Kanaka Creek near Alleghany.

Trinity County: Gold tellurides, probably hessite, occur in some of the mines of the Carrville district.

Tuolumne County: Occurred in the old Reist mine on Whiskey Hill, Silliman[6]. Is present in the Jumper and Bonanza mines near Jamestown.

57. PETZITE.

Telluride of silver and gold $(Ag,Au)_2Te$.

Massive. Color steel-gray to black. Streak black. Metallic luster. H=2.5—3; G=8.7—9.0.

Similar to hessite in its reactions, but yields more gold in the buttons. Hessite and petzite may grade into each other so as to be indistinguishable by the blowpipe.

Petzite is usually associated with hessite, sylvanite and calaverite. It is the commonest form of the gold telluride found in the State.

Calaveras County: Found with hessite in the Stanislaus and Melones mines on Carson Hill. Specimens from the Stanislaus mine have been analysed by Genth[4] and Kustel[1].

	Au	Ag	Te
Genth	25.55	41.93	32.52 per cent
	25.70	42.36	31.94
Kustel	24.80	40.60	35.40

El Dorado County: Found with calaverite at the Darling mine about three miles northeast of American Flat.

Inyo County: Occurs at Telluride in the Gilt Edge claim seven miles southeast of Olancha.

Siskiyou County: Has been found in the northern part of county near the State line, with calaverite and free gold.

Tuolumne County: One of the tellurides in the Golden Rule, Rawhide Ranch and Norwegian mines near Tuttletown. Analysed from the Golden Rule mine by Genth[4] and from the Norwegian mine by Hillebrand[1].

	Au	Ag	Te	Se	MnO	
Golden Rule	25.60	41.86	32.68	--	--	=100.14 per cent
	24.97	40.87	34.16	--	--	=100.00
Norwegian	25.16	41.87	33.21	tr.	0.08	= 99.32

58. ALTAITE.

Telluride of lead, PbTe.

Isometric. Small octahedrons and massive. Color tin-white to dark gray. Metallic luster. H=3; G=8.16.

The yellow coating of lead and the violet solution for tellurium serve to determine it.

Altaite is found associated with hessite, petzite and gold tellurides in a few localities.

Calaveras County: Occurred with hessite and petzite at the Stanislaus mine, Carson Hill, and analysed by Genth[4].

Pb	Ag	Au	Te	
60.71	1.17	0.26	37.31	= 99.45 per cent

Nevada County: One of the minerals at the Providence mine, Nevada City, occurring in bunches in the Ural vein intergrown with native gold and associated with quartz, pyrite and galena, Lindgren[6].

Tuolumne County: Occurred in the Golden Rule mine, near Tuttletown, Genth[4]. Also at Sawmill Flat with the forms (111) and (322) and was partly analysed by Sharwood, Eakle[1].

Pb	Ag	Au	Te
65.0	tr.	none	35.0

59. COLORADOITE.

Telluride of mercury, HgTe.

Massive, granular. Color iron-black. Metallic luster. H=3; G=8.63.

A white coating of telluric oxide and globules of mercury are obtained when roasted on charcoal. Gives the characteristic reaction for tellurium like tetradymite.

The telluride of mercury is a very rare mineral, and only one specimen has been found in the State.

Tuolumne County: Hillebrand[1] found one specimen which he identified as coloradoite, associated with the other tellurides of the Norwegian mine near Tuttletown.

60. MELONITE.

Telluride of nickel, Ni_2Te_3.

Hexagonal. Commonly granular and foliated. Cleavage perfect basal. Color reddish white. Streak dark gray. Metallic luster.

The tellurium is readily driven off in white oxide fumes when heated on charcoal. The roasted residue yields the brown bead of nickel with borax. Gives also the characteristic violet solution of a telluride when boiled in strong sulphuric acid.

This rare telluride has only been found in one locality, and there is some question of its exact formula.

Calaveras County: The rare telluride of nickel was discovered among the other tellurides of the Melones mine on Carson Hill in 1867 and was named by Gentli[3] [1], for the mine, and therefore should have been called *meloncsite*. A similar mineral was later found in the Stanislaus mine and analysed by Hillebrand[1].

	Te	NiCo	Pb	Ag	
Genth	73.43	20.98	0.72	4.08	=99.21 per cent
Hillebrand	80.75	18.31	--	0.86	=99.92

61. SYLVANITE—Graphic Tellurium.

Telluride of gold and silver, $(Au, Ag)Te_2$.

Monoclinic. Bladed crystals and massive. Cleavage perfect clinopinacoidal. Color yellowish silver-white. Streak silver gray. Metallic luster. H=1.5—2; G=7.9—8.3.

The tellurium is easily driven off as an oxide by heat, leaving a button of gold and silver. The silver can be extracted from the button by nitric acid and silver chloride is precipitated from solution with hydrochloric acid.

This important telluride may be present in many of the gold districts where tellurium is found, as it is one of the commoner forms of tellurium. It has been identified in very few localities.

Calaveras County: Sylvanite was one of the tellurides occurring in the Carson Hill mines and was especially prominent in the Melones and Stanislaus mines. An analysis of it from the latter mine was made by Stetefeldt[1].

Te	Au	Ag
59.6	25.5	13.9

Trinity County: It has been found with gold in the Yellow Jacket mine, and with nagyagite at the Dorleska mine, Coffee Creek district.

Tuolumne County: Occurs in the Sugarman and Nigger mine, two miles north of Sonora.

Yuma County: Occurs with the gold in the Red Raven mine, Dobbins district.

62. CALAVERITE.

Telluride of gold and silver, $(Au, Ag)Te_2$.

Monoclinic. Crystals with striated faces; also massive. Color pale bronze-yellow to yellowish silver-gray. Streak yellowish gray. Metallic luster. H=2.5; G=9.04.

Similar to sylvanite in its reactions. Calaverite and sylvanite give deep violet solutions when boiled with concentrated sulphuric acid.

A chemical investigation of the various telluride minerals from the mines on Carson Hill by Genth[4], proved the existence of a new telluride of gold and silver which he named after the county, and therefore should have been called *calaverasite*. Since that original discovery, the mineral has been found in very valuable deposits at Cripple Creek, Colorado, and in Australia.

Calaveras County: Discovered at the old Stanislaus mine and later in the Melones mine, the latter mine being the only one of this famous group of mines on Carson Hill still in active operation. An analysis of the mineral from the Stanislaus mine was made by Genth[4].

Au	Ag	Te	
40.70	3.52	55.89	=100.11 per cent
40.92	3.08	(56.00)	

El Dorado County: Found with petzite in the Darling mine near Rock Creek, about three miles northeast of American Flat.

Siskiyou County: Reported from the northern part of the county near State line, associated with free gold and petzite.

63. NAGYAGITE.

Sulpho-telluride of gold, lead and antimony, $Au_2Pb_{14}Sb_3Te_7S_{17}$.

Orthorhombic. Generally foliated and granular. Perfect cleavage into thin flexible laminae. Dark lead-gray color and streak. Metallic luster. H=1—1.5; G=6.85—7.2.

Gives the yellow and white coatings of lead, antimony and tellurium oxides, when roasted on charcoal, with a slight odor of sulphur. The presence of tellurium can best be tested by boiling in sulphuric acid and obtaining the violet color.

This is a very rare telluride and has only been observed at one locality in California.

Trinity County: Observed with hessite at the Dorleska mine, Coffee Creek district.

SULPHANTIMONITES.

64. BERTHIERITE.

Sulphantimonite of iron, $FeSb_2S_4$.

Long prismatic. Usually fibrous massive. Color dark steel-gray. Streak grayish black. Metallic luster. H=2—3; G=4—4.3.

A slight coating of white oxide of antimony and a slight odor of sulphur can be obtained by roasting on charcoal. The roasted mineral becomes magnetic.

This is a rare iron compound and its existence in the State has not been definitely established.

Tuolumne County: Heavy ledges of dark ore occur in an area of schists on the southeast slope of Mount Gibbs, which appear to be an impure berthierite mixed with galena, pyrite and quartz, Turner[4].

65. JAMESONITE—Feather Ore.

Sulphantimonite of lead, $Pb_2Sb_2S_5$.

Orthorhombic. Generally fibrous massive. Cleavage perfect basal. Color lead-gray. Streak grayish black. Metallic luster. H=2—3; G=5.5—6.0.

The yellow and white coating on charcoal of lead and antimony oxides and odor of sulphur are obtained by heating. Dissolved in nitric acid, the lead goes into solution, while the antimony is precipitated as an oxide.

Jamesonite is one of the common lead sulpho-salts and is often present in silver-lead districts, sometimes in large masses.

Calaveras County: Found at Mokelumne Hill, Hanks[6].

Inyo County: Compact massive specimens have come from the Cerro Gordo mine, associated with argentiferous galena.

Napa County: The delicate capillary or hair-like variety was found with cinnabar at the Manhattan mine, near Knoxville.

66. BOURNONITE.

Sulphantimonite of lead and copper $(Pb,Cu_2)_3Sb_2S_6$.

Orthorhombic. Short prismatic and tabular crystals and massive. Color and streak lead-gray. Metallic luster. H=2.5—3; G=5.7—5.9.

Fuses easily and on charcoal gives a white coating, at first of antimony oxide, followed by a yellow coating of lead oxide nearer the assay. Dissolved in nitric acid and ammonia added, the solution turns blue; soluble in hydrochloric acid with odor of hydrogen sulphide.

Bournonite is occasionally found in silver-lead districts where copper is also a constituent of the veins. It occurs in good crystals as well as massive.

Inyo County: The only known occurrence of the mineral is at Cerro Gordo, where it is found massive, Reid[4].

67. MIARGYRITE.

Sulphantimonite of silver, $AgSbS_2$.

Monoclinic. Crystals and granular massive. Color black to steel-gray. Metallic luster. Streak cherry-red. H=2—2.5; G=5.30.

Fuses easily on charcoal with the emission of sulphur fumes and gives a white coating of antimony oxide. Continued oxidation with the blowpipe produces a silver button. Soluble in nitric acid with the separation of sulphur and antimony trioxide.

Miargyrite is one of the rare forms of silver compounds and has not been reported from the silver deposits of this country, perhaps on account of its resemblance to pyrargyrite when massive.

San Bernardino County: A large part of the ore of the Coyote mine near Randsburg is miargyrite instead of ruby silver, as was supposed. Fine monoclinic crystals have been found.

68. PYRARGYRITE—Dark Ruby Silver.

Sulphantimonite of silver, Ag_3SbS_3.

Hexagonal, rhombohedral. Prismatic crystals. Also massive. Color grayish black, or dark red. Streak purplish red. Metallic luster. H=2.5; G=5.85.

Gives a white antimony oxide coating on charcoal and reduces to a globule of metallic silver. The sulphur can best be detected by fusion in a closed tube.

The ruby silver ore is found in silver veins as a secondary mineral and is associated with argentite, polybasite, stephanite, tetrahedrite and other silver minerals. It is characteristically found as dark gray blotches and bands with red streaks, in massive white quartz.

Alpine County: It occurred in the old I X L and Exchequer mines of the Silver Mountain district.

Kern County: Found associated with argentite at the Amalie mine.

Mariposa County: One of the minerals found in the Bryant Silver mine, associated with argentite and proustite.

Mono County: In the Oro, Addenda, Fortuna and other mines south of Bodie pyrargyrite and stephanite were abundant. Crystals were found in a vugg in the Bodie mine. Pyrargyrite also occurred in the Blind Spring mines, in the Tower mine, and in other mines near Benton, Whiting[1].

Nevada County: Found in a specimen from the Allison Ranch mine, associated with pyrite, chalcopyrite and galena; also in the Central mine south of Banner Hill, and is probably present in other mines of the Grass Valley and Nevada City district as indicated by the silver-rich concentrates, Lindgren[6].

Shasta County: Small amounts of pyrargyrite were occasionally found in the mines near Igo.

69. TETRAHEDRITE—Gray Copper.

Sulphantimonite of copper, $Cu_5Sb_2S_7$.

Isometric, tetrahedral. Generally massive. Color dark steel-gray. Streak black, sometimes cherry-red. Metallic luster. H=3—4.5; G=4.4—5.1.

Refractive index: $n = >2.72$.

Gives a slight white coating on charcoal and a faint odor of sulphur. The roasted mineral gives the blue bead of copper with borax. Soluble in nitric acid and the antimony precipitates as trioxide. Ammonia added will give the characteristic blue solution of copper, and precipitates any iron present.

The steel-gray metallic tetrahedrite is quite common in many of the gold and copper mines of the State. It is, however, seldom prominent but occurs in small amounts mixed with galena, sphalerite, chalcopyrite and other common sulphides.

Freibergite is the argentiferous variety and is perhaps the most common form of the mineral in California.

Tennantite is a sulpharsenite of copper and while really a distinct mineral, it may be considered as a form of tetrahedrite with its antimony replaced by arsenic. The two minerals are seldom differentiated.

Alpine County: Considerable tetrahedrite has been found in the Silver Mountain district.

Calaveras County: Small amounts of the mineral were found in the mines on Carson Hill. Present in the ore at the Jones mine, Carson Creek.

Del Norte County: Found at Crookeshine.

Imperial County: Occurred in the Blue Jacket and other mines of the Picacho district.

Inyo County: Tetrahedrite was an important mineral in the Cerro Gordo district containing a large percentage of silver. Occurred also in some of the White Mountain mines, in the mines of the Dutton Range and in the old San Carlos mine.

Los Angeles County: Found in the Zapate mine in the San Gabriel Canyon.

Mariposa County: A common mineral in the gold mines of the county, associated with quartz, pyrite, galenite and sphalerite. The silver-rich variety freibergite was found in large masses in white quartz, at the Live Oak mine, near Mariposa, Hanks[6]. The mineral also occurred in the Pine Tree mine near Coulterville. In the Louisa and Bunker Hill mines.

Mendocino County: In the Redwood Copper Queen mine with chalcopyrite, gold and silver.

Mono County: An important silver ore in several districts. In the Diana, Comet, Comanche and other mines of the Blind Spring Hill

district, it occurred massive associated with partzite. Also found in the Bodie district.

Nevada County: A heavy mass was found in the Osborn Hill vein, associated with zincblende and chalcopyrite. In small quantities at the North Banner and at other mines of the Banner Hill and Willow Valley districts, Lindgren[6]. It is present in the ore in the Badger Hill mining district.

Placer County: Dark steel-gray tetrahedrite associated with other sulphide minerals and with electrum was quite common in the Ophir district, having been noticed in the Boulder, Gold Blossom, Pine Tree and Golden Stag mines, Lindgren[4]. Observed at Michigan Bluff.

Plumas County: Found at the Irby Holt mine in Indian Valley. Argentiferous tetrahedrite was found at the Trask and Coffer mine. Observed in small amounts in the ore at Eugels.

Riverside County: A small amount of gray copper ore was found in association with chalcopyrite, pyrite and galena, at Crestmore.

San Bernardino County: It has been found massive in the New York and other mines in the New York Mountains.

Shasta County: Gray copper is of rather common occurrence in the copper mines of the county although in small amounts. It has been found in a barite gangue in the Bully Hill mine.

Tuolumne County: Occurred as one of the minerals on Whiskey Hill, Silliman[5]. Found massive in the Golden Rule mine, near Jamestown.

70. GEOCRONITE.

Sulphantimonite of lead, $Pb_5Sb_2S_8$.

Orthorhombic. Generally massive, granular or earthy. Color bluish lead-gray. Streak lead-gray. Metallic luster. H=2.5; G=6.3—6.45.

Gives the same reactions as jamesonite.

Geocronite is one of the very rare lead minerals found in the State.

Inyo County: According to Hanks[6], small masses were found with galena in the Inyo Mountains.

Mono County: It was observed in the Garibaldi mine, Prescott district, associated with galena and sphalerite.

71. STEPHANITE—Brittle Silver—Black Silver.

Sulphantimonite of silver, Ag_5SbS_4.

Orthorhombic. Crystals common, usually with striated faces. Also massive. Color iron-black. Streak black. Metallic luster. H=2—2.5; G=6.2—6.3.

The reactions are similar to those for pyrargyrite, but the streak or powder is black, whereas pyrargyrite is reddish.

Stephanite is a very important and usually prominent silver mineral in silver districts but it does not appear common in California. It is

often associated with argentite and polybasite as an original mineral of the veins.

Alpine County: Said to have been found in the Morning Star mine, J. D. Dana[1].

Mono County: In the Blind Spring Hill district it occurred as one of the associate minerals. Large masses were found with pyrargyrite in the Oro, Addenda and Fortuna mines, Bodie district, Whiting[1]. Also one of the minerals of the Sweetwater Range north of Bridgeport.

Nevada County: One of the minerals found in the Grass Valley mines, Lindgren[6].

Shasta County: Occurs with native silver, galena and sphalerite in a calcite-quartz gangue at the Igo consolidated mines.

72. POLYBASITE.

Sulphantimonite of silver, Ag_9SbS_6.

Orthorhombic. Tabular crystals and massive. Color iron-black. Streak black. Metallic luster. H=2—3; G=6.2.

In its blowpipe reactions polybasite is like stephanite and pyrargyrite.

Polybasite closely resembles stephanite; the two are often mixed and are seldom differentiated. When in good crystals they can be told apart but when massive their separate identification is difficult.

Alpine County: The only reported occurrence of polybasite is from this county. Specimens have come from the Pennsylvania mine in the Silver Mountain district, and Hanks[6] observed it in microscopical crystals from the Monitor and Mogul districts.

SULPHARSENITES.

73. DUFRENOYSITE.

Sulpharsenite of lead, $Pb_2As_2S_5$.

Orthorhombic. Generally massive. Color dark lead-gray. Streak reddish brown. Metallic luster. H=3; G=5.56.

Refractive index: $n=2.72$.

Like jamesonite in its reactions, except that the more volatile fumes of arsenic trioxide, instead of the antimony, are given off.

This compound of lead is a very rare mineral and its existence in California is somewhat doubtful.

Inyo County: Reported to have been found in the Cerro Gordo district, Hanks[6].

74. PROUSTITE—Light Ruby Silver.

Sulpharsenite of silver, Ag_3AsS_3.

Hexagonal, rhombohedral. Prismatic crystals and massive. Color and streak scarlet-red. Adamantine luster. H=2—2.5; G=5.5.

Refractive indices: ϵ=2.711; ω=2.979.

The fumes given off by heat are more volatile than from antimony, and have a slight garlic odor. Otherwise the reactions are the same as for pyrargyrite. The two minerals often are intermixed or grade into each other.

The term "ruby silver" is given indiscriminately to proustite and pyrargyrite. Both minerals usually contain arsenic and antimony and they often grade into each other. The metallic gray pyrargyrite is more common than the transparent red proustite, but the two are often associated.

Kern County: Specimens of proustite with pyrargyrite have been found in the old Amalie district.

Mariposa County: The light ruby silver occurred with pyrargyrite and argentite in the Bryant Silver mine.

Mono County: Found in the Oro and Bodie mines, Bodie district, Hanks[6].

Shasta County: Occurred in the Chicago mine near Igo, associated with galena, pyrite and quartz.

75. ENARGITE.

Sulpharsenite of copper, Cu_3AsS_4.

Orthorhombic. Crystals and massive. Cleavage perfect prismatic. Color grayish black. Streak black. Metallic luster. H=3; G=4.4.

Fuses and gives a faint coating of arsenic. The roasted mineral can be reduced to metallic copper by fusion with sodium carbonate. The borax bead is blue. Soluble in nitric acid with the precipitation of a small amount of antimony trioxide. Famatinite gives a larger amount of antimony trioxide when dissolved in nitric acid.

Enargite is a valuable but not a common copper compound in the State. Very few of the copper districts show it even in small amounts.

Famatinite is a corresponding sulphantimonite of copper and the enargite of Alpine County appears to grade into this mineral.

Alpine County: Enargite was found in large masses associated with massive pyrite in the Mogul district and formed the chief copper mineral of the Morning Star and a few other mines of this locality. An analysis of the mineral was made by Root[1] from the Morning Star mine.

S	Cu	As	Sb	
31.68	47.21	14.06	6.19	=99.14 per cent

Crystals have the forms: (110), (001), (100), (010), Silliman[8] and (130), (250), (101), Eakle[7].

El Dorado County: Some enargite was found in the Ford mines near Georgetown.

Plumas County: Small amounts occur with the bornite and chalcopyrite at Engels.

CHAPTER IV.

HALOIDS: CHLORIDES, BROMIDES, IODIDES AND FLUORIDES.

Chlorides.
Calomel
Halite
Sylvite
Sal Ammoniac
Cerargyrite
Chlormagnesite
Atacamite
Eglestonite
Bromide.
Embolite
Iodide.
Coccinite
Fluoride.
Fluorite

CHLORIDES.

76. CALOMEL.

Chloride of mercury, Hg_2Cl_2.

Tetragonal. Small crystals. Color white, gray, brown. Adamantine luster. H=1—2; G=6.48.

Refractive indices: ϵ=2.656; ω=1.973.

On charcoal easily volatilizes and coats the coal white. The mineral is easily reduced to mercury globules by fusion with soda.

The calomel used in medicine is a manufactured product as the natural mineral is very rare. It is sometimes found in clear colorless crystals of a brilliant adamantine luster, and in white crystalline coatings, in cinnabar districts.

Napa County: White coatings of the mineral on metacinnabarite occurred at the Oat Hill mine.

San Mateo County: Small amounts of calomel associated with cinnabar, native mercury and eglestonite occur about five miles west of Palo Alto, Rogers [1].

77. HALITE—Rock Salt.

Chloride of sodium, NaCl.

Isometric. Cubes massive, granular and crusts. Cleavage perfect cubic Color white, reddish and colorless. Vitreous luster. H=2.5; G=2.13.

Refractive index: n=1.544.

Fuses with intumescence and gives a strong yellow flame. Easily soluble in water and has a taste.

Most of the salt produced in the State is obtained by the evaporation of the water of San Francisco Bay, yet extensive deposits of the mineral exist in the southern counties and some of them are mined. Salt is of very common occurrence in the desert regions, where former lakes existed, and the deposits reach considerable thickness in some localities, often alternating with beds of sulphates, borates, carbonates and mud

shales. Salt wells, salt springs, salt marshes, and salt-rivers occur in these arid plains and white incrustations of salt are often found along their borders.

Alameda County: The salt works at Alvarado evaporate the water of San Francisco Bay on a large scale, and the bulk of the salt produced in the State is obtained by this method.

Colusa County: Salt was obtained by evaporation from the saline springs on the Peterson Ranch in Antelope Valley, near Sites.

Glenn County: Salt springs occur in Salt Spring Valley, four miles north of Stonyford and some a few miles west of Elk Creek postoffice.

Imperial County: Effloresecences of salt on the dry plains of the Great Colorado Desert were early reported.

Inyo County: Salt is common in the dry valleys as white efflorescences and in solution in many of the springs, marshes and lakes of this county. In the borax district of Death Valley it is a common associate, and the bottom of this valley is an extensive salt marsh, into which the Amargosa River sinks. The waters of Owens Lake have been evaporated for salt and soda. Pure white crusts occur in Saline Valley and at Salt Wells.

Kern County: In the Mojave Desert region on the eastern side of the county, numerous salt lakes and wells occur. The alkaline desert from the Kern River to the Cañada de las Uvas is impregnated with salt. Salt and borax are associated at the Buckthorn, Indian and Mesquite springs.

Riverside County: The well-known Salton Sea is an extensive depression in the south central part of the county which was noted for its immense deposits of white salt and where thousands of tons have been gathered. It is now covered by the waters of the Colorado River and the salt works have been wholly obliterated. An analysis of this salt was made by Allen[1].

$NaCl$	CLl	No_2So_4	Gypsum	H_2O	Insol.	
94.54	0.31	3.53	0.79	0.14	0.50	=99.81 per cent

San Bernardino County: Numerous dry lakes exist in this county, all of which contain salt. Some of the salt near Daggett has been mined locally for chloridizing the silver ores of the district. A large lake deposit occurs in the desert about twenty-five miles southeast of Danby and the Surprise salt mines have produced large quantities. Bailey[1] reports a vein of rock salt 12 to 16 feet thick on the Avawatz Mountains. Crusts of the mineral associated with sodium, magnesium and calcium sulphate occur at the Mojave sink. Salt and borax with some nitrates exist along the Amargosa River, near the Inyo County line.

San Luis Obispo County: Along the shores of the Salinas River white crusts of salt can be found in many places. The Soda Lake in Carissa Plains is a dry lake in the eastern part of the county, and the surface contains crusts of salt and sodium sulphate.

Shasta County: Sandstones occur on Salt Creek, about twelve miles east of Redding, which are slightly impregnated with salt.

Solano County: Halite is obtained by evaporation of salt water from a gas well eight miles northeast of Suisun.

78. SYLVITE.

Chloride of potassium, KCl.

Isometric. Cubes and octahedrons; also granular massive. Cleavage perfect cubic. Colorless to white. Vitreous luster. H = 2; G = 1.97 — 1.99.

Refractive index: $n = 1.490$.

Resembles salt and tastes salt and slightly bitter, but is distinguished by its violet flame when fused.

The potassium salt is sometimes associated with the sodium salt, but, unlike the sodium chloride, it is very rare and no deposits of it occur in the State. The brines of Searles Lake contain potassium which may be sylvite in solution.

Inyo County: According to Bailey[1] sylvite occurs in traces in some of the springs of this county. Analyses of some of the impure salt covering depressions in Death Valley show low percentages of potassium chloride.

79. SAL AMMONIAC—Salmiac.

Chloride of ammonium, NH_4Cl.

Isometric. Crystals, crusts and efflorescences. Color white, yellowish. Vitreous luster. H = 1.5 — 2; G = 1.53.

Refractive index: $n = 1.642$.

Very easily volatile without fusion when heated and is wholly converted into dense white fumes. Heated in a closed tube with soda or lime, ammonia is given off which can be detected by odor. Soluble in water.

Inyo County: According to Bailey[1] sal ammoniac is found as efflorescences at some of the fissure springs in Death Valley.

Los Angeles County: A white crystalline incrustation of sal ammoniac was found in the Monterey shale of Burning Mountain, Rogers[5].

Santa Barbara County: Crusts 5 mm. thick, associated with sulphur, came from burning oil-shales on the Hope Ranch, Rogers[5].

80. CERARGYRITE—Hornsilver.

Chloride of silver, AgCl.

Isometric. Usually in thin plates and crusts. Sometimes massive. Color gray but generally tarnished brown. Highly sectile. Waxy. H=1 — 1.5; G=5.55.

Refractive index: ω=2.061.

Easily reduced on charcoal to metallic silver. Mixed with copper oxide it imparts to the flame the azure blue color of the copper chloride flame. Insoluble in acids, but soluble in ammonia.

Cerargyrite has been one of the most important silver minerals of the State. It is characteristic of silver deposits located in arid regions and is often abundant in such regions. It has been formed in general by solutions from above carrying alkali chlorides, obtained from the overlying strata, acting on the silver minerals of the veins and forming solutions of silver chloride, from which the mineral is precipitated along fissures and in cavities of the gangue, mostly in the oxidized zones of the deposit. It is usually accompanied by the chlorobromide, embolite, and occasionally by the iodide, iodyrite. Barite is a common gangue mineral.

Inyo County: Hornsilver with argentiferous galena, argentite and copper minerals has been found abundant in the Argus and Coso ranges and to some extent in the Darwin and Cerro Gordo districts. Hanks[6] mentions it from the Slate Range and in microscopical crystals at the Modoc mine near Darwin. Cerargyrite with cerussite occurs in the Noonday mine, Tecopa; associated with chrysocolla at the Bonanza King mine, Sherman district.

Kern County: The mineral has been found in the Amalie mine with pyrargyrite and native silver.

Mono County: Cerargyrite has been found in the Blind Springs district near Benton and in some of the mines of the Bodie district, but never in large masses. It occurs also in the Sweetwater Range.

Placer County: It occurred in small amounts as one of the minerals in the Ophir district, on Duncan Hill, Lindgren[4].

San Bernardino County: Hornsilver has been a very important silver mineral in the Calico and Barstow mines. The chloride, together with the chlorobromide, has been deposited along the fault planes and in the numerous fissures of brecciated vein-rock formed by much faulting. The minerals associated with the hornsilver of this region are embolite, cerussite, barite, pyrolusite, chrysocolla, malachite and jasper. It occurs with limestone associated with embolite, wulfenite, sphalerite, galena, cerussite and pyrite in the Silver Reef district, on the desert about forty miles east of Victor. It is associated with argentite and secondary from it at the Bonanza King mine on Providence Mountain and in the Imperial mine, Lava Beds district, about nine miles from

Lavic. Cerargyrite was reported as one of the minerals with borax at Searles Lake, but the locality was probably Calico. The silver deposits at Calico and Barstow have been fully described by Lindgren[1] and by Storms[1].

81. CHLOROMAGNESITE.

Chloride of magnesium, $MgCl_2$.

Efflorescence. Color white.

Refractive indices: $\epsilon = 1.59$; $\omega = 1.675$.

Mixed with copper chloride, the azure blue flame is obtained. Soluble in water and the magnesia is precipitated as magnesium pyrophosphate on addition of sodium phosphate.

Magnesium chloride exists in soluble state in the waters of some of the springs and lakes but its easy solubility prevents it from forming as a mineral except in the dryest climate.

San Bernardino County: White efflorescences of chloromagnesite occur at Saratoga Springs, near the southern end of Death Valley, Bailey[1].

82. ATACAMITE.

Hydrous oxichloride of copper, $Cu_2ClH_3O_3$.

Orthorhombic. Slender needles and fibrous reticulated masses. Color deep grass-green. H = 3 — 3.5; G = 3.7.

Refractive indices: $\alpha = 1.831$; $\beta = 1.861$; $\gamma = 1.880$.

Fuses and imparts an azure blue color to the flame. Readily reduced on charcoal to metallic copper. Silver nitrate added to a nitric acid solution of the mineral precipitates flocculent silver chloride. Ammonia added to a nitric acid solution gives a blue color to solution. Gives water in a closed tube, which reacts acid.

Atacamite is a very rare form of copper and its occurrence in California has not been definitely established.

Inyo County: J. D. Dana[3] gives this mineral from an unknown locality in this county. As the Cerro Gordo mine was the best known for rare minerals, the atacamite, if correctly identified, perhaps came from this mine.

83. EGLESTONITE.

Oxichloride of mercury, Hg_4Cl_2O.

Isometric. Minute crystals. Color yellowish brown, changing to black. Resinous to adamantine luster. H = 2 — 3; G = 8.327.

Refractive index: $n = 2.49$.

Easily reduced to globules of mercury. Soluble in nitric acid and silver nitrate precipitates silver chloride.

This is a very rare mercury mineral which has been found associated with cinnabar, metallic mercury and calomel.

San Mateo County: Minute yellow crystals of eglestonite occur about five miles west of Palo Alto in seams and cavities in the silicious material so common in the serpentine of the cinnabar districts, and the crystals were described by Rogers[4]. Forms: cube (100), octahedron (111), rhombicdodecahedron (110), and trapezohedron (211).

Hg	Cl
88.00	7.43

The mineral was associated with cinnabar, mercury, calomel, dolomite, magnesite, opal and quartz.

BROMIDES.

84. EMBOLITE.

Chlorobromide of silver, Ag(Br,Cl)

Isometric. Generally massive. Color green. Resinous luster. H=1—1.5; G=5.31—5.43.

Refractive index: $n=2.15$.

Heated in a closed tube with potassium bisulphate and pyrolusite, red vapors of bromine are set free. Heated in closed tube with galena, yellow lead bromide forms, which turns white on cooling. Silver nitrate will precipitate silver bromide from a nitric acid solution.

The greenish embolite has only been found in association with cerargyrite and in much smaller amounts.

Inyo County: Found with cerargyrite in the Indiana mine near Swansea, Hanks[6].

Mono County: In the Minnie mine, Sweetwater Range, with horn-silver, Hanks[6].

San Bernardino County: An associate of the cerargyrite in the Calico, Grapevine and Silver Reef districts. One of the minerals reported with borax at Searles Lake, probably, however, from the Calico district.

IODIDES.

85. COCCINITE.

Iodide of mercury, HgI.

Thin coatings. Color reddish brown.

Reactions for the iodine are similar to those for chlorine and bromine in embolite. Violet vapors are given off when heated in closed tube with potassium bisulphate and pyrolusite. With galena the sublimate is dark orange red hot, which changes to lemon yellow when cold.

Reduced on charcoal to metallic mercury.

Traces of iodine have been found in some of the springs of the State, but the occurrence of any iodide is questionable.

Kern County: This rare reddish brown iodide is said to have been found with stibnite in the San Emidio Canyon, J. D. Dana[3].

FLUORIDES.

86. FLUORITE.

Fluoride of calcium, CaF_2.

Isometric. Usually in cubes. Also massive, granular or compact. Cleavage perfect octahedral. Colorless, green, yellow, purple, blue, white. Vitreous luster. H=4; G=3.2.

Refractive index: $n=1.434$.

Fuses with some decrepitation. Gives reddish flame of calcium. Soluble in acids and calcium is precipitated by amonium oxalate. Mixed with potassium sulphate and fused in a closed tube, the glass becomes etched.

Fluorite is a common mineral, especially as gangue in lead districts with galena. It sometimes forms thick veins and becomes important as a flux. No good deposits are known in the State.

Contra Costa County: Small cubes of white fluorite were found on Mount Diablo with some copper minerals, Hanks[6].

Inyo County: Found as a gangue mineral with argentiferous galena in the Cerro Gordo, Darwin and other districts.

Los Angeles County: Fine specimens have come from the Felix mine near Azusa, consisting of purple and green masses and cubes. White fluorite occurred on Santa Catalina Island with galena and chalcopyrite.

Mono County: In the Ferris Canyon on the east slope of the Sweetwater Mountains green and violet crystals and masses occur.

San Benito County: Specimens have come from the western part of this county.

San Bernardino County: Green and purple fluorite comes from the Kings Fluorspar mine, Cave Canyon district, with some iceland spar. Occurs in the Cave Canyon district coated with black manganese oxide. Light green occurs near Barstow. Occurs near Ludlow and near Needles.

San Diego County: Occurs in large specimens of green color at Oak Grove, Palomar Mountains. A small amount is found at the Mountain Lily Gem mine, Aguanga Mountain.

CHAPTER V.

OXIDES OF HYDROGEN, SILICON AND SEMI-METALS

Hydrogen.
- Water

Silicon.
- Quartz
- Chalcedony
- Tridymite
- Cristobalite
- Opal

Semi-metals.
- Arsenolite
- Claudetite
- Valentinite
- Bismite
- Molybdite
- Cervantite
- Stibiconite
- Stibioferrite
- Partzite
- Stetefeldtite

OXIDE OF HYDROGEN.

87. WATER.

Oxide of hydrogen, H_2O.

Hexagonal when solid, as ice. Colorless. Brittle. H=1.5; G=0.916.
Refractive index: $n=1.333$.
Ice, refractive indices: $_{\epsilon}=1.313$: $_{\omega}=1.309$.

The mineral springs of California are very numerous and of a great variety. Many of them have a reputed medicinal value and have become popular health resorts.

Thermal springs are common and many of them represent the lingering remnant of a former volcanic activity of the region. Some owe their origin to the heat developed by decomposition of sulphides and other mineral bodies below, in the courses of the underground waters. These springs are usually strongly sulphurous as well as hot.

The salts most commonly found in the spring waters of the State are the carbonates, sulphates and chlorides of magnesium, sodium, calcium and iron. Traces of boron are found in many and in some localities like Clear Lake, Lake County, and the desert regions of Inyo and San Bernardino counties, boracic acid has been an abundant ingredient.

Some of the lakes are also strongly saturated with salts, and Mono Lake and Owens Lake are noted for the large percentage of solid contents of their waters, mostly sodium bicarbonate.

Stream waters are purest in granitic regions, less pure and harder in limestone regions, and quite impure and strongly alkaline in the arid regions.

Colusa County: There are many mineral springs in the county along Sulphur Creek.

Lake County: This county is the most noted one in the State for its mineral springs. Adams, Anderson, Bartlett, Castle, Harbin, Highland, Howard, Saratoga, Siegler, Soda Bay and Witter Springs are noted tourist resorts.

Mendocino County: Several mineral springs occur in the county. Vichy, Orr's and Duncan Springs are noted.

Napa County: There are several noted mineral spring resorts in the county. Aetna, Calistoga, Napa Soda, Napa Vichy, White Sulphur, Pope, Sequoia, and Walters Springs are well known, all of them containing mineral salts in solution.

San Luis Obispo County: The Paso Robles Hot Springs are the most noted in the State.

Sonoma County: Numerous springs exist in the county containing mineral salts in solution. Agua Caliente, Alder Glen, Barcal, Boyes, "The Geysers," Lytton, Mark West, and Skaggs are noted.

OXIDES OF SILICON.

88. QUARTZ—Silica.

Oxide of silicon, SiO_2.

Hexagonal, rhombohedral. Hexagonal prisms with pyramids very common and sometimes large. Compact and granular massive. Prominent conchoidal fracture. Colorless, white, yellow, red-brown, etc. Optically positive. Vitreous luster. H=7; G=2.65.

Refractive indices: $_{\epsilon}$=1.553; $_{\omega}$=1.544.

Infusible and insoluble in nitric or hydrochloric acids. Soluble in hydrofluoric acid. Fused well with a flux of sodium carbonate, the fusion dissolved in water and hydrochloric acid, when evaporated to dryness, will leave the silica as an insoluble residue. The hydrochloric acid solution, after all silica is removed, will give no precipitates of alumina, calcium or magnesium when treated successively with ammonium, ammonium oxalate and sodium phosphate, proving the mineral to be silica and not a silicate.

Silica constitutes about three-fifths of the solid crust of the earth; consequently quartz and chalcedony and their varieties are exceedingly common minerals. It is usual to class under quartz those forms of silica which are phenocrystalline, that is, those with a distinct crystalline structure, and under chalcedony those forms which are cryptocrystalline, that is, those so finely crystalline that they appear noncrystalline except under the microscope. Under each of these two mineral species are grouped many varieties based generally on color and structure.

Common quartz is an essential constituent of granites, granodiorites, quartz-porphyries, rhyolites, gneisses, schists, quartzites and sandstones, and is an accessory mineral in many other kinds of rock, either volcanic, metamorphic or sedimentary. Veins, ledges, seams and pockety masses of white quartz are common in volcanic and metamorphic

areas and much of it in California is gold-bearing. In ordinary rock decomposition silica remains as a residual product, as it is practically unattacked by the usual weathering agencies.

Rock crystal is the clear colorless variety which is seldom to be found except as hexagonal crystals. Fine large groups of these crystals are frequently found in the mines.

Amethyst is the variety colored violet by manganese or possibly titanium. It also occurs in groups of crystals, being rarely massive. Very little good amethyst has been found in the State.

Rose quartz is a massive variety colored pink by manganese. Some very deep colored rose quartz has been found.

Smoky quartz or *Cairngorm stone* is the hair-brown transparent variety, also in crystals, the color being due to carbonaceous material. The color is readily discharged or converted into citrine-yellow by heat and much of the so-called "false topaz" has been made in this way. This is a very common variety and some excellent large crystals have been found in the State.

Inclusions of other minerals in quartz are very common and have several varietal names.

Phantom crystals show the outlines of one crystal within another, due to inclusions of green chloritic matter or brownish earthy material arranged about the boundaries of the forming crystal during a stage in its growth. Some fine phantom crystals have come from near Placerville.

Sagenite or rutilated quartz is rock crystal pierced by long red needles of rutile. No good sagenite has been found in the State.

Thetis hairstone is rock crystal containing long hair-like fibers of asbestos or actinolite.

Aventurine or gold-stone is glassy quartz speckled with flakes of hematite or brown mica. Good aventurine is very uncommon.

Alameda County: Yellow crystals occur associated with glassy albite at the Newman mine on Cedar Mountain, twelve miles southeast of Livermore.

Alpine County: Fine specimens of rose quartz have been found in Hope Valley and in the Mogul and Monitor districts.

Amador County: Fine large specimens of rock crystal have come from Volcano and Oleta. This section has also produced good specimens of amethyst, smoky and rose quartz. Thetis hairstone has been found at Oleta.

Butte County: Smoky quartz occurs on the North Fork of Feather River. Fine rose quartz occurs near Forbestown; also clear crystal aggregates.

Calaveras County: Good rock crystal in fine large aggregates have been found in many of the gold mines. Mokelumne Hill, Green

Mountain gravel mine near Murphy. Angels and West Point have produced large crystals. Clear quartz crystals occur at the Jennie Lind mine.

Colusa County: The Colusa sandstone from near Sites is one of the best known in the State.

El Dorado County: Rock crystal, phantom crystals and smoky quartz have come from near Placerville, which are the best in the State. A fairly pure white quartz is found on the McDonald Ranch, near Shingle Springs. A large deposit occurs ten miles northwest of Placerville. Clear crystals are found in White Rock Canyon near Georgetown. Quartz with actinolite occurs near Fairplay.

Glenn County: The principal mineral output of the county is sand and gravel produced chiefly at Wyo and Willows.

Inyo County: Good rock crystal has been found in the Cerro Gerdo and Darwin districts.

Kern County: Rose quartz reported as occurring north of Kernville.

Los Angeles County: Thetis hairstone has been found near Los Angeles. Vein quartz some thirty feet thick has been reported to occur six miles northwest of Acton. Quartz in veins occurs between Lancaster and Muroc. Occurs on Moonstone Beach, Santa Catalina Island.

Marin County: Chert, quartzite and sandstone are the chief mineral products of the county, used for macadam. Quartz amygdules occur on Mt. Tamalpais.

Mariposa County: Fine rock crystal occurs at Mount Bullion.

Mono County: Rock crystal, amethyst and tabular drusy quartz have come from the Bodie district.

Monterey County: White quartz sand occurs in sand dunes at Del Monte and Carmel Bay.

Napa County: Good rock crystal occurs near Calistoga.

Nevada County: Good specimens of rock crystal are often found at Grass Valley and Nevada City. Large crystals occur near Washington.

Orange County: Sand quartz occurs with biotite and muscovite one mile northeast of Capistrano.

Placer County: Quartz containing green chlorite is found at Shady Run. Rock crystal occurs in the Ophir district. Rock crystals, some with inclusions of green chlorite, occur at Shady Run.

Plumas County: Rock crystal from the Granite Basin. Some deep colored rose quartz has come from Meadow Valley.

Riverside County: Rock crystal, smoky quartz and pink quartz in fine large crystal are associated with the gem tourmaline at Coahuila. Granular quartz occurs in the Crestmore limestone quarry. Quartz as massive quartzite occurs in large quantity on Eagle Mountains.

Sacramento County: Rock crystal is found at Folsom of fine quality.

San Bernardino County: Quartz with rutile needles has been found in the San Bernardino Range. Found as pseudomorphs after calcite at Hart. Clear white occurs in the Fremont mining district. Found associated with specular hematite and epidote in the San Bernardino Mountains about thirty miles northeast of San Bernardino.

San Diego County: Excellent specimens of rock crystals, smoky quartz and pink quartz are associated with the green and pink tourmaline of the county. Large groups of crystals and single crystals of a deep rose color occur in the pegmatite veins which carry the tourmaline, some at Pala, Mesa Grande and Rincon. Rock crystal with long and almost black needles of tourmaline occur at Pala. Crystals from Pala and Rincon have the forms: $(30\bar{3}1)$, $(40\bar{4}1)$, $(50\bar{5}1)$, $(11\bar{2}1)$, $(31\bar{4}1)$, $(41\bar{5}1)$, $(51\bar{6}1)$, Waring[1]. A deposit of rose quartz of some size occurs twenty-nine miles from Tia Juana on road to Ensenada. An opalescent rose quartz occurs at Escondido. Tourmalinated quartz has been found on the east side of Chihuahua Valley.

San Luis Obispo County: Glass sand reported to occur about four miles south of Edna and also forty miles east of Arroyo Grande.

Sierra County: Yellow or citrine quartz has been found on Bald Mountain.

Stanislaus County: Large ledge of quartz about twelve miles above Patterson on El Puerto Creek.

Analysis:

SiO_2	99.78
Al_2O_3	0.21
Fe_2O_3	None

Tulare County: Rock crystal occurs at Three Rivers and in Drum Valley. Rose quartz is found at Bull Run Meadows and at Yokohl. Quartz with inclusions of hornblende is found at Deer Creek. Beautiful rose quartz occurs at the Summer Rose Quartz claim, eight miles southeast of California Hot Springs near Kern county line. Rose quartz of good color occurs on the west side of Bull Run Ridge, near county line associated with graphic granite. Good rose quartz occurs near Lemon Cove and near Badger. Excellent rose quartz occurs on the Gasenberger Ranch near Exeter, in a pegmatite associated with massive black allanite.

89. CHALCEDONY.

Silicon dioxide, SiO_2.

Refractive index: $\beta = 1.537$.

Reactions the same as with quartz. An impurity of iron will usually be shown on the addition of ammonia to the hydrochloric acid solution after the silica is removed.

The chalcedonic forms of silica are never transparent, but occur in dense cryptocrystalline masses and layers, translucent to opaque, and without crystal form. Hot solutions, especially alkaline solutions, acting on silicious rocks dissolve some of the silica and this is deposited in layers along the walls of cavities, or completely fills cavities, forming geodes and irregular shaped masses, with often a banded structure. Many of the large masses of chalcedony and jasper have been formed by deposition from springs, whose waters contain soluble silica. Chalcedony is a very common secondary filling of cavities and fissures in volcanic rock, and may form large geodes in this way. There are many names given to the varieties of cryptocrystalline silica which may be classed under the head of chalcedony, most of them based on color or structure. They include *chalcedony, agate, carnelian, sard, prase, heliotrope* or *bloodstone, chrysoprase, onyx, sardonyx, jasper* and *flint,* all of which may be found in the State. Ordinary silicified wood and agatized wood are silicious pseudomorphs after wood.

Myrickite is a local name applied to a chalcedony, having blood-red spots and patches of cinnabar.

Kinradite is a local name given to a spherulitic jasper occurring on the shores of Golden Gate.

Alameda County: Small geodes of chalcedony are common in the Berkeley Hills.

Alpine County: Red jasper is common in the Monitor district.

Amador County: Bluish chalcedony occurs at Volcano.

Calaveras County: Red, green and brown jasper is found near Murphy. Silicified wood at Angels.

Del Norte County: Agate, chalcedony and jasper pebbles are common beach pebbles at Crescent City.

El Dorado County: Some chalcedony occurs with the quartz at Georgetown.

Fresno County: Chrysoprase has been found fifteen miles northwest of Coalinga. Banded, delicately-veined masses of white chalcedony occur at Panoche.

Humboldt County: The beach pebbles at Big Lagoon are agate, chalcedony, jasper, prase, carnelian, etc.

Imperial County: Fine agates are found as drift pebbles in Colorado Desert, near Canyon Springs.

Inyo County: Porcelain jasper has been found in the Coso district.

Kern County: Deep blue and sky blue masses of chalcedony occur near Kane Springs.

Los Angeles County: The beach pebbles at Redondo are largely chalcedony.

Marin County: The beach pebbles at Bolinas have agate and chalcedony. Red jasper outcrops on Reed Ranch. Spherulitic jasper, called "kinradite," occurs on shore west of Sausalito between Point Bonito and Lime Point. Some of the beach pebbles at Bolinas Point are used for moonstones. The red and yellow jaspers from the Franciscan cherts make beautiful polished specimens.

Mendocino County: Red jasper is quite common at Shelter Cove.

Napa County: Red jasper is found on Mount St. Helena. Chalcedony is common at the Manhattan cinnabar mine, Knoxville. The petrified wood of the Petrified Forest near Calistoga is largely chalcedony.

Nevada County: Brown jasper occurs at Nevada City. The beach pebbles at Lake Tahoe contain chalcedony, agate, jasper, carnelian, prase, etc. Good moss agate is found near Indian Flat.

Placer County: Fine geodal masses of chalcedony have been found at the Spanish mine, Ophir district.

Plumas County: Banded green and red jasper occurs in the slates and schists west of Meadow Valley.

San Benito County: Bluish gray chalcedony occurs as pseudomorphs after elongated crystals of barite and also forms shells about oily bituminous matter, in the Phipps Quicksilver mine, east of Emmet.

San Bernardino County: Moss agate has come from the San Bernardino Mountains. Bluish chalcedony is associated with opal in the Black Mountains north of Barstow. Myrickite occurs forty-five miles northeast of Johannesburg and fifteen miles northeast of Lead Pipe Springs, in bunches and small masses. Fine blue chalcedony occurs two miles northeast of Lead Pipe Springs. Bloodstone occurs in vesicular basalt with jasper near Lead Pipe Springs.

San Diego County: Red and white banded chalcedony occur southeast of Dulzura and east of Donohue mine. The amethystine-colored chalcedony found east of San Diego has been called "violite."

San Francisco County: Red, green and brown jasper is common in the serpentine of San Francisco. Spherulitic jasper called "kinradite" is found near Land's End.

San Mateo County: The beach pebbles at Pescadero contain fine specimens of chalcedony, agate, carnelian, jasper, etc.

Santa Barbara County: The beach pebbles of this county contain agate and chalcedony.

Siskiyou County: Jasper is common with the numerous serpentine beds.

Sonoma County: Red jasper is found at Windsor.

Trinity County: Jasper occurs on Red Mountain at the head of Prospect Peak.

Tulare County: Fine moss agate occurs on Deer Creek. Chrysoprase is found in the hills east of Visalia, on Deer Creek and at Yokohol. Chrysoprase was mined at Venice Hill, Stokes Mountain, on Tule River, Deer Creek and one mile east of Lindsay.

Tuolumne County: Yellow and brown jasper occurs at Shaws Flat.

90. TRIDYMITE.

Oxide of silicon, SiO_2.

Hexagonal. Thin plates often overlapping. Colorless to white. H = 7: G = 2.28 — 2.33.

Refractive indices: $\alpha = 1.467$; $\beta = 1.47$; $\gamma = 1.473$.

Reactions the same as with quartz.

Tridymite is a form of silica which is found in recent volcanic rocks. It occurs in thin and often overlapping hexagonal plates, crystallizing as a secondary mineral in the cavities and fissures of the rock. The mineral is generally of microscopic size and therefore is rarely seen, except in thin sections of rocks. As a rock mineral it may occur in all of the recent volcanics.

Mono County: Observed in the cavities of lava as small hexagonal plates, near Bridgeport, with the forms: (0001), $(10\bar{1}0)$, $(32\bar{5}0)$, $(54\bar{9}0)$, $(30\bar{3}4)$, $(10\bar{1}2)$, Schaller[6].

Shasta County: Occurs abundantly in vesicular basalts on road to Terry's Mill, east of Round Mountain.

Tuolumne County: Found by Rogers[5] in cavities of an andesite near Jamestown. Occurs as very thin, white hexagonal plates.

91. CRISTOBALITE.

Silicon dioxide, SiO_2.

Isometric. Small octahedrons. Color white. Dull luster. H = 6—7: G = 2.27.

Refractive index: $n = 1.468$.

Insoluble and infusible, like quartz. An isometric modification of SiO_2 formed at temperatures above 1100°.

Tehama County: Occurs as constituent of rock near Tuscan Springs. Rogers[7].

Tuolumne County: Occurs as distinct octahedral crystals in augite andesite (auganite) near Jamestown. Rogers[7].

92. OPAL.

Hydrous oxide of silicon, $SiO_2.nH_2O$.

Amorphous. Colloidal massive. Prominent conchoidal fracture. Yellow brown, green, red, white, gray and colorless. Waxy luster. H=5.5—6.5 of compact varieties. G=2.1—2.2.

Refractive index: $n=1.406—1.46$.

Gives a slight amount of water in a closed tube, otherwise like quartz and chalcedony in its reactions.

Opal differs from chalcedony in being wholly amorphous, somewhat softer and containing a varying percentage of water. It is silica which has solidified from a colloidal state. It fills cavities and seams in many different kinds of rock and is a very common form of silica.

Precious opal shows a beautiful play of colors and very little of this variety has been found in the State.

Common opal is the white, yellow, brown, bluish or greenish masses with no opalescence, having a prominent choncoidal fracture. The occurrence of this kind is quite universal.

Hyalite is transparent glassy opal occasionally found in the cavities of volcanic rock.

Cacholong is a pearl-like opal.

Chrysopal or *prase opal* is a name applied to a greenish opal found with chrysoprase.

Moss opal is common opal with moss-like inclusions of pyrolusite, chlorite, etc.

Wood opal is very abundant in the State, especially in the foothills of the Sierras, where whole forests have been covered by the great thickness of gravel. Masses of wood opal are sometimes white, but usually light to dark brown in color. The structure of the wood is often so well preserved that the species can be identified.

Geyserite and *silicious sinter* are names applied to hydrous silica formed about the vents of geysers and hot springs.

Diatomaceous earth, infusorial earth and *tripolite* are names applied to deposits of silica formed by fresh or salt water diatoms. The waters of the lakes during Tertiary time swarmed with infusoria which secreted silica and their silica remains have formed thick and extensive deposits of white and very light chalk-like material.

Alpine County: Wood opal occurs at Red Lake Peak.

Amador County: Wood opal at Volcano. Diatomaceous earth in Ione Valley.

Butte County: Wood opal at Dodson mine.

Calaveras County: Common and hyalite opal has been found at Mokelumne Hill. Wood opal at Chile Gulch, Bald Hill, Angels and other mining camps.

Contra Costa County: Hyalite and common opal has been found on Mount Diablo.

Fresno County: Dendritic or moss opal has come from the mountains east of Fresno. Some diatomaceous earth is reported a few miles southwest of Mendota.

Inyo County: Diatomaceous earth reported from Independence Valley near main highway.

Kern County: White opal is found on the summit of Tehachapi Mountain. Fine moss and dendritic opal occurs eighteen miles northwest of Johannesburg.

Lake County: Fiorite opal has been found at Sulphur Bank. Hyalite has come from Middletown and Kelseyville. Diatomaceous earth occurs on Lost Spring Ranch.

Lassen County: Wood opal is found in Surprise Valley. Yellow and white have been found near Honey Lake.

Los Angeles County: Diatomaceous earth at Santa Monica and on Santa Catalina Island. A deposit of diatomaceous earth is reported as occuring near Bairdstown. Also in the bluffs three miles south of Redondo; at Point Duma, northwest of Santa Monica; at Palos Verdes Ranch, San Pedro Hills and near Acton.

Merced County: Diatomaceous earth of good quality occurs in the hills west of Newman.

Modoc County: A deposit is said to occur in Secret Valley.

Mono County: Diatomaceous earth has come from near Bodie.

Monterey County: The Monterey shales grade into pure diatomaceous earth. A bed of diatomaceous earth occurs nine miles northwest of Bradley.

Napa County: Wood opal in large trees occurs in the fossil forest near Calistoga. Some diatomaceous earth occurs in Friend's Valley west of Calistoga; also four miles southeast of St. Helena.

Nevada County: Wood opal at Chalk Bluff, Nevada City, North Bloomfield, and Shelly Hill. Masses of moss opal are found at Newtown.

Orange county: Diatomaceous earth around Allison Creek south of El Toro.

Placer County: Wood opal at Gold Run and near Roseville. Diatomaceous earth at Dutch Flat.

Plumas County: Wood opal in Gravel Range.

Riverside County: White hyalite coats the walls of some of the small cavities in the feldspathic pegmatite at Crestmore. It shows strong yellow luminescence under the electric spark, indicating the presence of uranium. Wood opal of a dark brown color also occurs at the quarry.

San Bernardino County: Opal occurs in the Black Mountains about 25 miles north of Barstow, some of which is good gem material and is worked. Most of it is common opal with chalcedony. Some clear

hyalite occurs with it. Common white, colorless hyalite, red, and gem opal occur in cavities in rhyolite two miles northeast of Lead Pipe Springs. An opal deposit occurs about twenty-five miles north of Barstow, in Copper Mountain.

San Diego County: Thin coatings of glassy hyalite occur on the quartz and albite at Rincon, Rogers[3]. Diatomaceous earth has come from about forty miles north of San Diego.

San Francisco County: Nodular masses of common opal occur in the serpentine of San Francisco. A moss or dendritic opal occurs on the Black Hills.

San Joaquin County: Diatomaceous earth is found on Staple's Ranch.

San Luis Obispo County: Diatomaceous earth occurs near Port Harford, near Arroya Grande and near Edna. Several occurrences of diatomaceous earth are reported: In the mountains back of Pismo; in the hills on the south side of San Luis Valley; in the San Luis Range south of Morro Bay; various points in Salinas Valley as far north as Rinconada.

San Mateo County: Diatomaceous earth at San Gregorio.

Santa Barbara County: A large deposit of diatomaceous earth occurs at Lompoc. Also on south slope of Santa Ynez Mountains and near Santa Barbara. Diatomaceous earth is exposed in low hills south of Surf and along the coast south of Goleta.

Shasta County: Diatomaceous earth is found in extensive beds along the Pit River and on Hat Creek. A pure white diatomaceous earth occurs a few miles southwest of Bartle in T. 37 W., R. 3 E.

Sierra County: Wood opal has come from Downieville.

Siskiyou County: Fire opal has been found near Dunsmuir.

Sonoma County: Wood opal near Santa Rosa; diatomaceous earth about ten miles north of Petaluma; geyserite at the Geysers. Yellow masses occur on hills north of Sonoma. Some opal of gem quality has been found near Glen Ellen. Fire opal has been found in a clay deposit on the Weise Ranch, between Glen Ellen and Kenwood. Infusorial earth occurs as a five-foot-thick bed, one mile north of Mark West Springs and six miles east of Windsor. A deposit occurs also two miles northeast of Agua Caliente.

Tehama County: Diatomaceous earth near Lassen Butte. Probably is volcanic tuff.

Tulare County: Wood opal in Kings River Canyon. Diatomaceous earth near Exeter. Chrysopal or prase opal is a nickel green opal found with chrysoprase in hills east of Visalia and Porterville. Yellow opal occurred with chrysoprase at Yokohol.

Tuolumne County: Wood opal has been found near Columbia.

OXIDES OF SEMI-METALS.

93. ARSENOLITE—White Arsenic.

Oxide of arsenic, As_2O_3.

Isometric, commonly fibrous crusts and earthy. Color white. Silky or vitreous luster. H=1.5; G=3.7. Taste sweet. Astringent.

Refractive index: $n=1.785$.

Fusible with white fumes and garlic odor. Gives no sulphur in closed tube.

The white oxide of arsenic is readily obtained by heating any arsenic compound but it is not very common native.

Alpine County: Found as an alteration of enargite at the Exchequer mine. Small white octahedrons occur in the pyrite and enargite associated with realgar at the Monitor mine.

San Bernardino County: Large masses occurred with gold at the Amargosa mine. W. P. Blake[9].

94. CLAUDETITE.

Trioxide of arsenic, As_2O_3.

Monoclinic. Platy crystals. Perfect clinopinacoidal cleavage. Colorless to white. H=2.5; G=4.05.

Refractive indices: $\alpha=1.871$; $\beta=1.92$; $\gamma=2.01$.

Dense white fumes and garlic odor when heated on charcoal.

A mineral formed by oxidation of arsenides of metals, and is rare.

Trinity County: Occurs in crusts of well-formed monoclinic crystals in the pyrrhotite deposit at Island Mountain.

95. VALENTINITE.

Trioxide of antimony, Sb_2O_3.

Orthorhombic. Generally columnar masses. Perfect brachypinacoidal cleavage. Color snow-white to ash-gray. H=2.5; G=5.56.

Refractive indices: $\alpha=2.18$; $\beta=2.35$; $\gamma=2.35$.

Gives white coating, but no odor on charcoal. Gives no sulphur in closed tube.

Valentinite is an oxidation product of antimony minerals, especially of stibnite.

San Benito County: Lemon-yellow bladed aggregates of valentinite, probably pseudomorphs after stibnite, occur at the Picahotes mine associated with cinnabar, quartz and chalcedony, Rogers[5].

San Bernardino County: Occurs as white coating on stibnite in northern part of county.

96. BISMITE—Bismuth Ocher.

Oxide of bismuth, Bi_2O_3.

Orthorhombic. Commonly occurs as an earthy coating. Color yellow to gray. G=4.36.

Refractive indices: ϵ=1.82; ω=2.00.

Gives yellow coating on charcoal, which becomes bright red when fused with potassium iodide and sulphur.

Bismite occurs generally as a yellowish powder or coating on bismuth minerals, especially on native bismuth.

Mono County: Found at Lone Pine.

San Diego County: Bismuth ocher was found as a yellow and gray powder with native bismuth at Pala, Kunz[5]. This powder is, according to Schaller[9], in part bismuth hydroxide, bismuth vanadate and mixtures of these two. An analysis of the yellow ocher from the Stewart mine showed it to be a mixture of the hydroxide and the vanadate.

		Gang		H_2O			
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	210°	Ign.	
64.43	12.11	2.27	17.63	0.32	0.224	3.43	=100.43 per cent

An analysis of the gray ocher from the Stewart mine showed it to be probably bismuth hydroxide with the formula $Bi_2O_3.3H_2O$.

		Gang		H_2O			
Bi_2O_3	V_2O_5	Sol. in HNO_3	Insol. in HNO_3	107°	240°	Ign.	
64.9	0.8	9.5	13.5	0.4	0.3	11.4	=100.8 per cent

An analysis of the yellow ocher from the Pala Chief mine showed it to be the bismuth vanadate, pucherite.

Yellow bismite in small irregular particles and minute tabular crystals with the forms (100) and (011) occur at the Victor mine, Rincon, Rogers[2].

97. MOLYBDITE—Molybdic Ocher.

Oxide of molybdenum, MoO_3.

Capillary crystals in radiating tufts and earthy. Color straw-yellow. H=1—2; G=4.5.

Refractive indices: α=1.720; β=1.733; γ=1.935.

A deep blue solution is obtained by dissolving the powder in concentrated sulphuric acid and adding a scrap of paper not larger than a pin head. The solution soon turns brown.

Molybdite occurs as a yellow powder or as small radiating tufts as a secondary alteration product of molybdenite. Most of the localities given for molybdenite will show some of the yellow oxide.

Del Norte County: Found associated with bornite at French Hill.

Mono County: Occurs with molybdenite at Cameron and at Silverado Creek, Whiting[1].

Nevada County: Occurred mixed with limonite at the Wisconsin and Illinois claim, Nevada City. And in Stuart Ledge.

Shasta County: Occurs on Boulder Creek west of Gibson Siding, associated wth molybdenite.

Tuolumne County: Found in some of the rocks on the Stanislaus River.

98. CERVANTITE—Antimony Ocher

Oxide of antimony, Sb_2O_3.

Orthorhombic. Usually as a crust or powder. Sometimes massive. Color yellow. H=4—5; G=4.08.

Refractive index: $n=1.98$.

Differs from valentinite in being infusible and the antimony coating on charcoal is obtained only when reduced by means of a flux like sodium carbonate.

Cervantite usually occurs as a yellowish crust or powder as an oxidation product on stibnite.

Inyo County: Found massive yellow at the Lottie mine, Wild Rose district and at the St. Ignacio mine.

Kern County: Occurred associated with stibnite at the San Emidio mine.

99. STIBICONITE.

Hydrous oxide of antimony, $Sb_2O_4H_2O$.

Massive or as a crust or powder. Color yellowish white. H=4—5.5; G=5.1—5.28.

Refractive index: $n=1.60$—1.9.

Reactions like cervantite, but also yields water in a closed tube.

Occurs as an alteration product of stibnite or native antimony in massive crusts or powder, of a yellowish white color. It is the common oxidation of antimony minerals.

Kern County: Found with native antimony at Little Caliente Springs and on Erskine Creek.

San Benito County: Occurs with stibnite at some of the mines of the northeast part of the county.

Santa Clara County: Found with stibnite at some of the mines of the county.

100. STIBIOFERRITE.

Hydrous oxide of antimony and iron.

Amorphous. Color straw-yellow. Resinous luster. H=4; G=3.6.

This oxide was found as a thick coating on stibnite from Santa Clara County and was described as a new mineral by Goldsmith(4). The analysis of the substance suggests that it was a mixture of stibiconite and silicious limonite and not a new mineral.

Sb_2O_5	Fe_2O_3	H_2O	SiO_2	Ign.
42.46	31.85	15.26	8.84	1.09

101. PARTZITE.

Hydrous oxide of antimony, copper and other bases.

Massive. Color blackish green to black. H=3—4; G=3.8.

Blackish green to black masses occurring in the oxidation zone in the mines of the Blind Springs district.

Stetefeldtite is similar to partzite with more silver.

Mono County: Found in the Kerrick, Comanche, Diana and Comet mines of the Blind Springs district and described as a new mineral and analysed by Arents[1]. Considered, however, by W. P. Blake[12] to be a mechanical mixture of the hydrous oxide of antimony with other metallic bases.

Sb_2O_3	Cu_2O	Ag_2O	PbO	FeO	H_2O	
47.65	32.11	6.12	2.01	2.33	8.29	=98.51 per cent

A specimen labeled stetefeldtite has come from the Giant mine.

CHAPTER VI.

OXIDES OF THE METALS

Anhydrous.		*Hydrous.*
Cuprite	Cassiterite	Manganite.
Periclase	Rutile	Turgite
Melaconite	Anatase	Göthite
Massicot	Brookite	Limonite
Litharge	Chrysoberyl	Bauxite
Corundum	Hausmannite	Brucite
Hematite	Minium	Pyrochroite
Ilmenite	Crednerite	Sassolite
Spinel	Braunite	Psilomelane
Magnetite	Pyrolusite	Asbolite
Chromite		Wad

ANHYDROUS OXIDES.

102. CUPRITE—Red Copper.

Red oxide of copper, Cu_2O.

Isometric. Small cubes and octahedrons. Generally massive. Color red. Streak brownish red. Adamantine to submetallic luster. H = 3.5 — 4. G = 5.99.

Refractive index: $n = 2.849$.

Mixed with sodium carbonate, it is easily reduced on charcoal to metallic copper; ammonia added to the nitric acid solution produces a deep blue color, but no precipitate if mineral is pure.

Cuprite occurs in most of the copper localities as a secondary mineral in the oxidized portions of the deposits. Massive specimens have come from various counties but no large bodies of the mineral are known. It is an important ore of copper. *Chalcotrichite* is a long hair-like variety.

Alameda County: Massive specimens have been found near Livermore.

Amador County: At Volcano.

Calaveras County: Masses are occasionally found at Copperopolis and Campo Seco, associated with the chalcopyrite. Mentioned by Silliman[5] from Quail Hill.

Colusa County: Found at the old Candace and Union mines. The capillary variety *chalcotrichite* with massive cuprite was found in the Lion mine.

Del Norte County: Masses with native copper found at the Pearl copper mine. Common in the Rockland district.

El Dorado County: Found with malachite, chalcopyrite and native copper at the Cambrian mine.

Fresno County: Prominent in the Gordon-Fresno Copper mine.

Glenn County: At L'Homme.

Humboldt County: Occurs associated with native copper and malachite on Horse Mountain. Occurs with melaconite, chalcocite and malachite on the Fields Lebanon property, Red Cap Creek.

Kern County: Found on the old San Emidio Ranch.

Lassen County: Fine specimens have come from the Lummis mine.

Modoc County: Excellent specimens of cuprite with malachite, native copper, and chrysocolla have come from the Christy mine, Fort Bidwell, and from the Leitz mine, seven miles south of Fort Bidwell.

Mono County: Massive at the Eclipse, Kerrick and Mammoth mines. Also near Lundy with cerargyrite and chrysocolla. Occurs with native copper at the Cavin mine, Copper Mountain, twenty-two miles southwest of Bodie. Excellent specimens of cuprite with malachite and melaconite are found in the Detroit Copper mine, Jordan district, about six miles northeast of Lundy.

Napa County: Found near Calistoga and St. Helena, some of it the chalcotrichite variety.

Nevada County: Occurs with chalcocite and native copper at Meadow Lake. Occurs with chalcocite and malachite at the Oro Grande mine.

Placer County: Massive near Lincoln. Occurs at the Elder mine with chalcopyrite.

Plumas County: In Light's Canyon. With native silver at the Pocahontas mine, Indian Valley.

Riverside County: Occurred in quantity at the Red Cloud mine, Chuckawalla Mountains.

San Bernardino County: Massive in Holcombe Valley. Common at the Copper World mine, Clarke Mountain.

Shasta County: Massive pieces have been found at the Peck, Afterthought, Copper City and other mines of this county.

Trinity County: Massive at Trinity Center.

Tulare County: In the Mineral King district.

Tuolumne County: At Whiskey Hill, Silliman[5].

103. PERICLASE.

Oxide of magnesium, MgO.

Isometric. Cubes and octahedrons. Cubic cleavage. White or colorless. H=6; G=3.67—3.90.

Refractive index: $n=1.736$.

Infusible, but completely soluble. Ammonia and sodium phosphate added to hydrochloric acid solution precipitates magnesia. Alters to brucite.

A very rare mineral found in crystalline limestone.

Riverside County: Occurred in the crystalline limestone at Crestmore, but is altered to brucite and hydro-magnesite. Found also in the City Quarry at Riverside, Rogers[8].

104. MELACONITE—Tenorite—Black Copper.

Oxide of copper, CuO.

Monoclinic. Generally as an earthy powder. Color black. Streak black. Submetallic luster. H=3—4; G=5.82.

Refractive index: β=2.63.

Same reactions as obtained from cuprite. Distinguished by color.

The black oxide of copper is a frequent oxidation product of chalcopyrite, forming a black powder or nodular masses. It occurs in many more localities than what can be given here.

Calaveras County: Rather common with the chalcopyrite of Copperopolis and Campo Seco. Large nodular masses have come from the Satellite mine. Associated with melaconite and malachite at the Telegraph mine, Hog Hill.

Colusa County: Found in serpentine with native copper and cuprite at the Gray Eagle mine.

Del Norte County: With the chalcopyrite at the Alta and Pearl mines.

Inyo County: The black oxide of copper occurred with chrysocolla, azurite and malachite in the Greenwater district.

Mono County: Associated with cuprite and the copper carbonates at the Detroit Copper mine.

Nevada County: At the Excelsior mine.

Shasta County: At the Afterthought and other chalcopyrite mines of this county.

105. MASSICOT.

Monoxide of lead, PbO.

Tetragonal? Usually in scales or scaly masses. Color brownish orange-red. H=2; G=7.98.

Refractive index: β=2.64.

Fuses easily to a yellowish glass. Easily reduced on charcoal to metallic lead and yielding yellow coating.

Kern County: Has been found in scaly masses near Fort Tejon.

Placer County: Said to occur at the Rescue mine, or in that vicinity.

San Bernardino County: Crystalline scaly masses occur on Cucamonga Peak, associated with litharge and were described by Larsen[2].

106. LITHARGE.

Monoxide of lead, PbO.

Orthorhombic. Scaly masses. Color lemon-yellow to orange-yellow. H=2; G=8.

Refractive index: β=2.61.

Fuses easily to a yellow glass. Easily reduced on charcoal to metallic lead, and gives yellow coating.

San Bernardino County: Occurred with massicot on Cucamonga Peak, Larsen[2].

107. CORUNDUM.

Oxide of aluminium, Al_2O_3.

Hexagonal, rhombohedral. Prismatic crystals and massive. Cleavage rhombohedral. Color generally bluish gray; also blue, green, yellow and red. Vitreous luster. H=9; G=3.95—4.10.

Refractive indices: $_{\epsilon}$=1.760; $_{\omega}$=1.768.

Infusible and insoluble. Fragments moistened with cobalt nitrate and intensely heated assume a sky-blue color. Necessary to fuse it with sodium carbonate in order to get it into solution and precipitate the alumina in the wet way.

Corundum-bearing rocks are very rare in the State and no workable deposits of this useful mineral are known. In the few localities where it occurs it exists in very limited quantities. The gem varieties, ruby and sapphire, have not been found in good clear crystals.

Los Angeles County: The first mention of corundum in the State was of some sapphire-blue pebbles found in the drift of the San Francisquito Pass, W. P. Blake[9]. Crystals of ruby corundum occur in a corundum syenite in San Antonio Canyon, near Uplands.

Plumas County: Large crystals of a pale violet-blue shade occur in the plumasite of Spanish Peak, Lawson[3].

San Bernardino County: Found in the Kingston Range, Kunz[7].

San Diego County: A constituent of the dumortierite schist of Deheza, Schaller [5]. Occurs in a vein with garnet in a mica schist on the north slope of San Miguel Mountains, 26 miles east of San Diego, in pink colors and as opaque gray crystals. Blue corundum is reported from Tule Mountain, north of Jacumba.

108. HEMATITE—Red Ocher.

Sesquioxide of iron, Fe_2O_3.

Hexagonal, rhombohedral. Crystals, compact massive, granular, micaceous and earthy. Color black, red, brown. Streak red and reddish brown. Metallic, submetallic or earthy dull. H=5.5—6.5; G=4.9—5.3.

Refractive indices: $_{\epsilon}$=2.94; $_{\omega}$=3.22.

Gradually acted on by strong acids, and ammonia precipitates ferric hydrate. Becomes magnetic on heating. Gives little or no water in closed tube.

Hematite is the chief iron mineral and large deposits occur in California awaiting development. It occurs massive black, and massive and earthy red. The crystalline black masses are found in connection with the crystalline metamorphic and igneous rocks while the red earthy masses are sedimentary alterations of iron bearing minerals. Red hematite mixed with brown limonite forms the common gossan capping of iron sulphide deposits. The flaky specular variety, often termed "specularite," is a common constituent of the crystalline rocks of the State.

Martite is a pseudomorph of hematite after magnetite. Much of the magnetite of the State shows a change into hematite and martite is common in the magnetite-hematite deposits.

Alameda County: Massive red earthy hematite mixed with limonite forms the capping of the pyrite body at Leona Heights.

Alpine County: Massive black specimens are common at Monitor.

Amador County: Small amounts occur about two miles west of Ione. Impure hematite occurs in a body two miles west of Ione, and also one-half mile northwest of Clinton.

Butte County: Common in the gravels at Magalia, Butte Creek, Oroville and Stirling City. Specular hematite is found at Bangor.

Calaveras County: Small amounts found at Douglas Flat, Murphy, Wallace and Quail Hill.

Colusa County: Good massive hematite occurs forty miles west of Willows. A red hematite suitable for mineral paint occurs in a deposit four miles southwest of Lodoga.

Del Norte County: Found at the Kelsey Tunnel, fourteen miles southeast of Crescent City.

El Dorado County: Heavy masses at Shingle Springs. In the gravels at Diamond Springs, Green Valley and Virner.

Humboldt County: Large vein three miles south of Centerville. Red ocher is found near Garberville and also eight miles from Ferndale. Some soft red ocher occurs on Jones Creek, two miles northeast of Arcata. Some specular hematite occurs at Orleans in the Humboldt mine. Massive red hematite on Rainbow Ridge; associated with manganese deposit as red ocher at Fort Baker.

Inyo County: Massive specular hematite occurs at the Defiance mine. Also found in Owens Valley, Hanks[6]. A large deposit of specular hematite is found near Alvord Station. Specular variety is found in large masses in the Inyo Mountains, seven miles east of Kearsarge Also in the White Mountains. Red hematite occurs five miles north of Shoshone. Fine specular variety in the Grapevine Range.

Kern County: At Cane Springs and Ricardo. A deposit of some size of specular variety occurs in a mica schist at the foot of Mt. Breckenridge, about twenty miles north of Caliente. Red ocher occurs in the Red Rock district.

Lake County: Massive red near Glenbrook. In Cobb Valley. A deposit of red ocher used locally occurs in Jerusalem Valley, near Dollar Springs.

Lassen County: Excellent specimens of specular hematite have come from near Susanville.

Madera County: One of the largest deposits of magnetite-hematite occurs in the Minaret Mountains. Much of this ore is martite.

Marin County: Massive specimens have come from the Maillard Ranch, about two miles southwest of San Geronimo.

Mendocino County: A red ocher once used for paint is found on Porter Creek, ten miles southwest of Healdsburg. Large crystalline masses occur seven miles east of Round Valley on Eel River. Some red ocher is found in Anderson Valley and some near Covelo.

Modoc County: Hematite flakes occur along the Feather River.

Mono County: Common mineral in the Blind Spring district. Abundant masses of specular hematite occur in the andalusite mass on White Mountains in the southern part of the county, Knopf[5].

Napa County: Massive red occurs near St. Helena. Massive at White Sulphur Springs and Blaisville. Red and brown masses of hematite and limonite occur at the Sterling Iron mine, St. Helena. Red ocher deposit on Benoli Mountain, two miles south of Calistoga.

Nevada County: Associated with gold at Meadow Lake, Lindgren[5]. Minor deposits occur at Indian Springs and at Newtown.

Orange County: Observed at Fullerton.

Placer County: Some hematite occurs with magnetite at the Hotaling deposit about six miles north of Auburn. Small amounts occur at Clipper Gap, Red Hill and near Weimar.

Plumas County: With magnetite near Crescent Mills; at Mumford's Hill, Light's Canyon, Genessee Valley and Nelson Point. Foliated masses of specular hematite in quartz occur on north side of Diamond Range. Specular hematite mixed with magnetite occurs as a vein very close to the Diadem Lode. Black masses with magnetite occur near Moonlight, eleven miles north of Taylorville. Occurs common at the Engels copper mine.

Riverside County: Considerable hematite is associated with, and has been formed from, magnetite, at the extensive Eagle Mountain deposit. The specular variety associated with green epidote is common in the Monte Negro district. Some of the cellular cavities formed by leaching out of brucite are filled with red hematite, at Crestmore.

San Benito County: Reported to occur at the old Quilty Iron mine.

San Bernardino County: The numerous iron deposits of the Mojave Desert have hematite and magnetite in heavy black masses. The deposits near Dale, on Iron Mountain, in the Kingston Range, at Cave Canyon, Newberry, on Providence Mountain near Kelso and elsewhere in the county are massive hematite after magnetite, or martite. A soft red ocher occurs in the Calico district, five miles west of Yermo. Found massive on Sheephole Mountain.

San Diego County: Black massive hematite in Eagle Peak Canyon.

San Joaquin County: Earthy red hematite as shale occurs at the Ladd manganese mine.

San Luis Obispo County: A vertical bed about ten feet wide in shale can be traced crossing Prefumo Canyon, in the mountains south of Los Osos Valley.

Shasta County: The Redding or Pitt River deposit of hematite has been utilized at the electric smelting furnace at Heroult. The capping of the pyrite beds of this county are thick deposits of earthy hematite and limonite.

Siskiyou County: The gravels of the Shasta River show specular hematite.

Sonoma County: Deposits are reported near Fort Ross and near the west fork of the Guelala River. Hematite occurs on the Lancaster Ranch, east of Fisk's Mills. A large body is said to occur six miles east of Fort Ross. A silicious variety occurs on Porter Creek, about ten miles southeast of Healdsburg.

Stanislaus County: A foliated variety occurs near La Grange.

Tehama County: Minor deposits occur at Beegum.

Trinity County: In the sands at Trinity Center. Specular variety occurs in the vicinity of Burnt Ranch.

Yuba County: In the sands of the Brownsville district.

109. ILMENITE—Menaccanite—Titaniferous Iron.

Oxide of iron and titanium, $(FeTi)_2O_3$.

Hexagonal, rhombohedral. Plates, massive, in rounded pebbles and grains. Color black. Streak dark brown to black. Metallic luster. H=5—6; G=4.5—5.

Magnetism usually increased by heating. Fused with sodium carbonate and the flux dissolved in hydrochloric acid, the solution turns reddish or bluish violet when reduced with metallic tin.

Ilmenite resembles hematite and magnetite so closely that it is not often differentiated. The black beach sands and the black concentrates in the gold fields contain much of the mineral in small grains and rolled pebbles. In most of the localities given below it exists in the sands.

Amador County: Near Volcano.

Butte County: At Oroville, Cherokee, Little Rock Creek, Brush creek, and Inskip.

Calaveras County: San Andreas, Murphy and Wallace in considerable amount.

Del Norte County: At Crescent City.

El Dorado County: In the Brownsville district, at Green Valley, Placerville, Grizzly Flats. Its occurrence is mentioned at Georgetown, Hanks[9].

Fresno County: It occurs with rutile near Friant.

Humboldt County: At Upper Gold Bluff.

Imperial County: Mass occurs near Niland.

Kern County: A large constituent of the black sands at Vaughn.

Los Angeles County: In the beach sands at Ocean Park.

Madera County: With magnetite in the Minaret Mountains.

Mariposa County: Near Princeton and in dolomite as crystals near Mariposa.

Nevada County: At Rough and Ready, Nevada City, North Bloomfield and Relief Hill.

Orange County: At Fullerton.

Placer County: At Gold Run.

Plumas County: At Spanish Ranch, Crescent Mills, Genessee, La Porte and Nelson Point. Occurs intergrown with hematite and magnetite at Engels. Good crystals have been found at Genessee.

San Bernardino County: Near Needles.

San Francisco County: A constituent of the dikes cutting across the city.

San Luis Obispo County: A constituent of the beach sands of the county.

Santa Barbara County: At Point Sal.

Santa Cruz County: At Aptos.

Shasta County: At Round Mountain, French Gulch and Redding.

Siskiyou County: In the sands of Jackson Creek, Happy Camp, Forks of the Salmon, Sawyers Bar, Scott River and Shasta River.

Trinity County: At Junction City, Carrville, Minersville and on Trinity River.

Tulare County: Occurs with specular hematite and magnetite near Orosi.

Tuolumne County: At American Camp.

Yuba County: At Marysville, Brownsville, Yuba River, Strawberry Valley, Indian Hill and Oregon House.

110. SPINEL.

Oxide of aluminium and magnesium, $MgO.Al_2O_3$.

Isometric. Small crystals; rounded grains. Color ruby-red, blue, green, brown and black. Vitreous luster. H=8; G=3.5—4.1.

Refractive index: n=1.723—1.75.

Infusible and insoluble. Fused with sodium carbonate, dissolved in hydrochloric acid, the solution yields alumina hydrate on the addition of ammonia, and white magnesium pyrophosphate on the further addition of sodium phosphate, thus distinguishing it from corundum.

Spinel occurs only as a rock constituent and exists in some of the gold sands as ruby-red grains resembling red garnet. *Picotite* is a brown spinel containing chromium and iron which occurs in the serpentine rocks. *Pleonaste* is an iron-magnesia spinel.

Butte County: Small crystals of ruby spinel have been found in the rock of the diamond mine near Oroville.

Humboldt County: Ruby spinel occurs in the beach sands at Gold Bluff.

Placer County: Picotite has been found at Rocklin, Hanks[6].

San Bernardino County: Black spinel occurs in the basalt flows south of Pipes Canyon. Sec. 21 and 22, T. 1 N., R. 4 E.: also in basalt near Quail Springs, T. 1 S., R. 7 E., S. B. M.

San Diego County: Blue spinel was reported to occur in the Mack mine near Rincon; the deep green, pleonaste variety, in small octahedrons, occurs there, associated with garnet, Rogers[3].

San Luis Obispo County: Ruby spinel has been observed near San Luis Obispo, Kunz[7].

Siskiyou County: Picotite occurs in the basalts of Mount Shasta, Hanks[6].

111. MAGNETITE—Magnetic Iron.

Oxide of iron, Fe_3O_4.

Isometric. Octahedral crystals, compact and granular massive. Color iron black. Streak black. Metallic luster. H=5.5—6.5; G=5.1. Strongly magnetic.

Very magnetic. Soluble in hydrochloric acid, and reddish ferric hydrate precipitated on the addition of ammonia. Distinguished from hematite by streak and magnetism.

Magnetite is one of the most abundant of the iron minerals and good deposits of it occur in the State. It is a constituent of all igneous rocks and in such condition exists in all of the counties. It forms the bulk of the black sands. Most of magnetite occurs with the metamorphic schists and gneisses, and in igneous rocks. Often occurs along the contact of igneous intrusions through metamorphic or sedimentary rocks. Some of the magnetite is titaniferous, grading toward ilmenite.

Lodestone is the variety possessing polarity forming a natural magnet.

Alameda County: Octahedral crystals occur in the schists of North Berkeley.

Amador County: Large boulders have been found at Volcano, W. P. Blake[1]. On Sutter Creek.

Butte County: Abundant in the drift workings at Magalia, in the gravels on Butte Creek and in the dredging sands at Oroville. In the concentrates at Stirling City, Little Rock Creek, Brush Creek, Lovelock and Inskip. Masses occur near Oroville.

Calaveras County: In the concentrates at Douglas Flat, San Andreas, Murphy and Wallace. Some massive magnetite occurs on Carson Hill.

Del Norte County: At Crescent City, Gilbert Creek, on Smith River. Masses of pure magnetite in the French Hill mining district.

El Dorado County: Massive about two miles northeast of Shingle Springs and also fine octahedrons in chlorite. The lodestone variety has been found at Coloma. Common in the concentrates at Virnir, Green Valley, Grizzly Flats, Reliance mine and in the Brownsville district. Occurs at the Lilyoma mine, Pilot Hill, associated with galena, chalcopyrite, calcite, quartz and garnet as a contact deposit.

Fresno County: Lodestone has been found at the Sparkling Iron mine, Kings Creek district. Octahedral crystals associated with copper ore occur in Uncle Sam mine at Tehipite Dome, on Kings River. Occurs intermixed with bornite at Crown Creek opposite Tehipite Dome. Pure masses occur in the Cinnamon Bear district, Pine Flat.

Humboldt County: The greater part of the black constituent of the beach sands at Gold Bluff and Upper Gold Bluff is magnetite. Common also at Orleans and Trinidad.

Imperial County: Found massive near Palo Verde.

Inyo County: Large deposits are said to occur in the Olancha district near the Haiwee Dam.

Kern County: Abundant at Ricardo, Kane Springs and Vaughn in the black concentrates. Granular masses occur in the San Emidio mining district. Deposit of some size occurs at contact with mica schist, 1½ miles south of Woody.

Los Angeles County: Black sands at Ocean Park. Solid masses near Russ Station in Soledad Canyon. Small deposit in canyon about ten miles northeast of Acton; with garnet in the black sands of Santa Monica Bay.

Madera County: Large deposits of magnetite-hematite occur in the Minaret Mountains. Deposits occur on the west slope of Mount Raymond.

Mariposa County: Masses occur at the base of Mt. Hoffman.

Modoc County: In the drift and black sands of the Feather River.

Mono County: Found massive in the Benton, Bodie and Lundy districts, Whiting[1].

Nevada County: A deposit occurs about one mile west of Newtown and also about four miles south of Indian Springs at the contact between granodiorite and diabase. Common in the concentrates at Nevada City, Grass Valley, North Bloomfield, Relief Hill, and Rough and Ready. A small deposit in place at Diamond Creek, about one mile east of Omaha mine.

Orange County: In the sands at Fullerton.

Placer County: A deposit which was worked in 1881-1886 by blast furnace occurs at Hotaling, five miles west of Clipper Gap, on the

contact between diabase and quartzite. Octahedrons are common at Forest Hill. Common in the black sands and concentrates at Butcher Ranch, Michigan Bluff, Gold Run, East Auburn, in Blue Canyon, and on the North Fork of the American River. Masses of magnetite are found near Fallen Leaf Lake.

Plumas County: Common at Spanish Ranch, Genessee, La Porte, Nelson Point, Crescent Mills, and on Rock Island Hill, but only in small amounts. A large body of the ore occurs close to west shore of Wade's Lake. Found associated with hematite at Moonlight. Common in the rocks at Engels, sometimes intergrown with ilmenite.

Riverside County: One of the largest deposits of iron in the State occurs on Eagle Mountain. It is magnetite-hematite or martite ore.

Sacramento County: In the black sands at Michigan Bar.

San Benito County: A large deposit is said to be near Hollister.

San Bernardino County: Important deposits of magnetite occur in several localities in this county but are as yet not utilized. Good deposits on Iron Mountain, near Dale, at Owl Holes, on the Kingston Range, at Cave Canyon, Garlic Springs, Newberry, and on Providence Mountain. The Dale deposit has been described by Harder[2]. Massive lodestone exhibiting strong polarity has come from a deposit thirty miles southeast of Daggett.

San Francisco County: A constituent of the beach sands.

San Luis Obispo County: Common at La Panza.

Santa Barbara County: Common in the beach sands at Point Sal.

Santa Cruz County: On the Leonard Ranch, about one-half mile from the coast, magnetite occurs interstratified with beach sand which carries some gold.

Shasta County: Large deposit at Heroult on contact between diabase and slate was worked by electric smelter. Deposit near Baird. Occurs with hematite at Iron Mountain and at most of the copper mines. In the sands at French Gulch, Redding and Round Mountain. On contact between diabase and carboniferous limestone at Gray Rock and on McCloud River. A large deposit between quartz diorite and limestone about five miles east of Pit on the Sacramento and Eastern Railroad. Occurs as contact mineral with pyrrhotite and chalcopyrite at the Black Diamond mine.

Sierra County: Large beds said to occur in this county, W. P. Blake[3]. Fine perfect octahedrons have come from Forest City. A massive deposit occurs south of Lake Hawley in the Calaveras formation, and also southeast of Spencer Lakes.

Siskiyou County: In the black sands it is common at Happy Camp, Seiad, Cecilville, Forks of the Salmon, Sawyer's Bar, Scott River,

Oro Fino, Castella, Shasta River, Beaver Creek, Henley and Klamath River. A lodestone variety occurs near Weed.

Tehama County: Magnetite occurs in the Beegum district and is titaniferous.

Trinity County: In the black sands at Trinity Center, Douglas City, Junction City, Carrville, Minersville and along the Trinity River. Massive at Douglas City, and on the northwest side of Chauckelulla Mountain.

Tulare County: Massive at New Pass, W. P. Blake[1]. Massive near Three Rivers and on Greenhorn Mountain.

Tuolumne County: In the black concentrates at all of the mines.

Yuba County: Common at Marysville, Brownsville, Strawberry Valley, Indian Hill, Oregon House, Camptonville and on Yuba River. Occurs massive with hematite four miles from Clipper Mills.

112. CHROMITE—Chromic Iron.

Oxide of chromium and iron, $FeCr_2O_4$.

Isometric. Generally massive. Color black. Streak grayish brown. Metallic luster. H=5.5; G=4.32—4.57.

Refractive index: n=2.16.

Infusible and insoluble. Gives an emerald green bead of chromium with borax. Iron beads with borax are yellow to bottle green. Manganese beads are wine to violet.

In much of the chromite of the State magnesium replaces the iron, forming magnesium chromite. The mineral is formed in serpentine rocks, often as large boulder-like masses and irregular shaped masses. It is abundant in the serpentine areas of the State, and some tons of it are produced annually. It is also abundant in the black sands.

Alameda County: Pockets of massive chromite occur at the Mendenhall mine and other mines about sixteen miles southeast of Livermore in the Cedar Mountain district, sometimes coated with zaratite.

Amador County: Found near Jackson. Deposits near Ione; about eight miles northeast of Carbondale; five miles southwest of Plymouth, near Willow Creek.

Butte County: A constituent of the black sands at Magalia, Oroville, Cherokee, Buchanan Hill, Lovelock and Pentz. Massive near Forbestown. Deposits about one mile southwest of Big Bar; one mile east of Yankee Hill; five miles southwest of Magalia; one mile north of Woodleaf; east of Brush Creek; near Twin Cedars six miles east of Paradise; 2½ miles northeast of Forbestown. Small bodies occur at the Powell manganese mine, one mile north of Clipper Mills, and at Pentz.

Calaveras County: In the serpentine about five miles east of Valley Springs. In the concentrates at Forest Gulch. Deposits near Copper-

opolis; about seven miles west of Angels; four miles west of Fostoria; five miles southwest of Valley Springs; 10 miles northeast of Angels; fourteen miles east of Milton. Deposits occur on the Tower Ranch, nine miles east of Milton, and on the Wright Ranch, in Salt Spring Valley, ten miles northeast of Milton. A deposit at the Big Pine mine has been used for furnace lining at Campo Seco.

Colusa County: Massive at Newville. Occurs near Stonyford, near Wilbur Springs; 1½ miles northwest of Cook Springs.

Del Norte County: In the black sands of Smith River, on Gilbert Creek and at Crescent City. Good deposits on Rattlesnake Mountain, twenty miles east of Crescent City. Deposits at French Hill, near Smith River, in lenses eight feet thick; of considerable size on Copper Creek, Low Divide and Monkey Creek.

El Dorado County: Near Latrobe, near Coloma and at Shingle Springs. Three miles northeast of Georgetown near Latrobe; two miles south of Georgetown; in Marble Valley near Clarksville; analysis of chromite from the Donnelly deposit, ten miles northeast of Folsom, gave:

Cr_2O_3	SiO_2	FeO	Al_2O_3	MgO	CaO	Ign.
46.52	6.60	17.63	11.66	15.80	1.23	0.50=99.94

Large deposits at Flagstaff Hill, eight miles south of Auburn as granular masses in serpentine. Tons have been mined at the Pilliken Chrome mine, ten miles northeast of Folsom. Large deposit on the Williamson property, six miles east of Shingle Springs.

Fresno County: Deposits occur in the southwest part of the county in the Mount Diablo Range, and in the serpentine hills east of Fresno, from Letcher to Piedra. Deposits in Watt Valley, on Hog Mountain, and at Pine Flat.

Glenn County: Deposits occur near Millsaps; at Bedford, five miles east of Chrome; about six miles east of Newville; near Orland.

Humboldt County: Constituent of the beach sands at Gold Bluff, and of the concentrates at Orleans and Trinidad. Massive occurs near Blocksburg. Small masses on Horse Mountains; in the serpentine east of Orleans. Small bodies on the Hoopa reservation.

Kern County: Some small deposits on the Kern River.

Kings County: Some masses have been found in southwest corner of county near Parkfield.

Lake County: Pockets of chromite occur on the Pardee Ranch, near Middletown. Masses have been found in the mountains near Adams and Siegler Springs. Large body three miles northeast of Hullville; reported from Jerusalem Valley.

Los Angeles County: Deposit reported near Acton and near Harold Station.

Madera County: Found near Madera in masses coated with zaratite.

Marin County: Occurs on the Maillard Ranch near San Geronimo, about eight miles northwest of San Rafael.

Mendocino County: Found coated with green uvarovite garnet about ten miles north of Willits. Specimens have come from near Ukiah. Has been found at several points in hills west of Russian River. Occurs about twelve miles north of Willitts coated with uvarovite garnet. Deposits occur about 1½ miles west of Ukiah, on Red Mountain and in Potter Valley.

Monterey County: Common in small masses in the serpentine of this county, and specimens have been analysed, Goldsmith[3]. Masses occur about three miles east of Parkfield, on Table Mountain.

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	CaO	SiO_2	
52.12	2.18	15.24	12.29	5.65	12.12	=99.60 per cent

Napa County: Some small bodies have been found near Knoxville. Deposit occurs eight miles northwest of Monticello.

Nevada County: Fine octahedrons occur in the serpentine near Indian Springs. In the concentrates at Rough and Ready, North Bloomfield, and Relief Hill. At the Red Ledge mine, two miles southwest of Washington, the mineral occurs as a large body in serpentine near contact with mariposite schists. Has much uvarovite garnet and chrome chlorites coating the specimens. Masses occur in the vicinity of Grass Valley.

Placer County: A deposit occurs in serpentine near Green Valley below Towle, and also near Auburn. In the black sands of the North Fork of American River, of Blue Canyon, at Loomis, and at Michigan Bluff. Small deposits occur about 2½ miles from Dutch Flat; near Weimar; four miles from Colfax; in the Iowa Hill district and on Forest Hill Divide. Large deposits seven miles south of Newcastle as nodular masses coated with good crystals of uvarovite and micaceous rhodochrome and kämmererite. Lenticular masses occur in serpentine on the Scott property two miles east of Towle, and in Green Valley, nine miles southeast of Towle.

Plumas County: Common at Rock Island Hill, La Porte, and in Meadow Valley as concentrates. Bodies occur six miles south of Quincy, also three miles southwest of Crescent Hill, two miles north of Spanish Ranch and three-fourths mile southwest of Meadow Valley.

Sacramento County: A prominent constituent of the black sands at Michigan Bar. Massive occurs at Nigger Hill near Folsom.

San Benito County: Massive specimens coated with zaratite have come from near Hollister. Occasional masses are found in the serpentine near New Idria.

San Luis Obispo County: Mined in mountains southeast of San Luis Valley on the slope of the San Lucia Range. Occurs at the London mine, 4½ miles northeast of San Luis Obispo. Found at the head of Carpojero Creek and at La Panza. The chromite from the Pick and Shovel mine on Chorro Creek, six miles northeast of San Luis Obispo, has been analysed, Pemberton[1].

Cr_2O_3	Al_2O_3	Fe_2O_3	MgO	FeO	MnO	SiO_2	H_2O	
56.68	11.40	3.52	16.23	11.77	0.15	3.40	0.94	=100.09%

San Mateo County: Common in the beach sands. A few scattered masses occur near Crystal Springs Lake, west of San Mateo.

Santa Barbara County: Small deposit in hills southwest of Point Sal and one in the San Rafael Mountains south of Santa Ynez.

Santa Clara County: Found in small masses in the serpentine near Los Gatos and near New Almaden. Small amounts have been found in the hills east of Alum Rock Park. Small deposit on Righetti Ranch, three miles east of Coyote Station.

Shasta County: At French Gulch and in the black sands of the Sacramento River. Deposits of massive chromite occur near Castella. A series of lenses in a shear zone in serpentine occur north of Shotgun Creek. Large body in the northern part of the county on Little Castle Creek. Several bodies occur three miles east of Simons Station.

Sierra County: Occurs as pebbles in gravels at Howland Flat; also in Goodyear Creek near Downieville.

Siskiyou County: A good deposit near Dunsmuir coated with kämmererite. Massive near Callahan coated with uvarovite and zaratite. Very common as grains in the concentrates at Callahan, Grouse Creek, Happy Camp, on Scott River, Beaver Creek and in Seiad Valley. Deposits near Gazelle and on top of Forest Mountains. Massive near Edgewood.

Solano County: Small amounts have been found near Fairfield.

Sonoma County: Found at Litton Springs and near Cloverdale and Cazadero. In the hills near Camp Meeker; twelve miles east of Stewart's Point; small deposits back of Stewart's Point; small deposits back of the Geysers and on the Madera property, eight miles north of Guerneville.

Tehama County: Large deposits at Lowry mine and Kleinsorge mine on north fork of Elder Creek about twenty-eight miles west of Red Bluff. Large deposit ten miles east of Paskenta on Toms Creek.

Trinity County: In the sands at Trinity Center. Masses found at Island Mountain; reported from Carrville and near Weaverville; a small deposit ten miles south of Wildwood.

Tulare County: Some occurs near Three Rivers on the Nicola property.

Tuolumne County: Masses have been found 1½ miles west of Chinese Camp.

Yuba County: In the black sands at Camptonville, on the Yuba River, and on Indian Hill.

113. CASSITERITE—Tin Stone.

Oxide of tin, SnO_2.

Tetragonal. Twinned crystals and massive. Color brown and black. Streak gray or pale brown. Adamantine to dull luster. H=6—7; G=6.8—7.1.

Refractive indices: $_{\epsilon}$=2.093; $_{\omega}$=1.997.

Infusible and insoluble. With sodium carbonate on charcoal can be reduced to globules of metallic tin. These globules, intensely heated with cobalt nitrate, will give a bluish green coating.

This valuable oxide, from which practically all of the metallic tin is obtained, is rare in California. A few specimens of stream tin and a small deposit quickly exhausted, are all that have been found.

Placer County: Stream tin has been found near Michigan Bluff.

Plumas County: Stream tin was found in the bed of the middle fork of the Feather River, three miles above Big Bar, Hanks[6].

Riverside County: The Temescal tin mine was situated a few miles southeast of South Riverside in the Santa Ana Mountains. The oxide occurred in a rudely semicircular area of granite about two miles in diameter, as brownish masses and reddish brown crystals in a vein of tourmaline and quartz. Some layers of wood tin also occurred. An analysis of a fairly pure specimen of the ore was made by Genth, Fairbanks[5].

SiO_2	WO_3	SnO_2	CuO	$Al_2O_3Fe_2O_3$ MnO CaO
9.82	0.22	76.15	0.27	13.54

San Diego County: Small crystals were found associated with gem tourmaline, beryl and stibiotantalite, at Mesa Grande, Penfield and Ford[1]. Reported from the placer gravels on the east slope of Laguna Mountain; also from Pine Valley and from the south end of Viejos Mountain east of Alpine. Said to occur in the Defiance Copper district and on Aguanza Mountain. Crystals associated with topaz at the Little Three mine, Ramona. Occurs in a pegmatite dike about ten miles east of Oak Grove in the Chihuahua Valley, two miles south of the Riverside-San Diego county line, associated with quartz, feldspar, lepidolite, blue tourmaline, columbite and albite, Schaller[18].

Siskiyou County: Stream tin is not uncommon in the gravels at Sawyer's Bar and on Hungary Creek, a tributary of Klamath River.

Trinity County: Found as stream tin near Weaverville, Hanks[6].

114. RUTILE.

Oxide of titanium, TiO_2.

Tetragonal. Long prisms and grains; crystals often twinned. Color reddish brown to brownish black. Adamantine to metallic luster. Streak pale brown to colorless. H = 6 — 6.5; G = 4.18 — 4.25.

Refractive indices: $_\epsilon$ = 2.903; $_\omega$ = 2.616.

Infusible. Soluble sufficiently in hydrochloric acid to yield a blue-violet solution on reduction by metallic tin. With phosphorous salt (sodium ammonium phosphate) yields a delicate violet bead.

Rutile, as a rock constituent in microscopic crystals, is common in many of the metamorphic rocks of the State. Large crystals have not been found.

Amador County: Reported as needles in quartz, forming sagenite, at Tyler's ranch near Oleta.

Butte County: A constituent of the gold washings at Cherokee, Silliman[7].

Fresno County: Brownish red rutile crystals occur with ilmenite near Friant.

Humboldt County: First noticed in the State in the granite at Eureka.

Mono County: It occurs in small reddish brown crystals in white quartzite with bands of blue lazulite near Mono Lake.

Placer County: Has been observed at Michigan Bluff.

San Diego County: One of the constituents of the dumortierite schist at Dehesa, Schaller[5].

Santa Clara County: Found in the schists of Calaveras Valley and in much of the metamorphics of the Coast Range, Murgoci[1].

115. ANATASE—Octahedrite.

Oxide of titanium, TiO_2.

Tetragonal. Small pyramidal crystals. Cleavage perfect basal and prismatic. Color brown. Adamantine to metallic luster. H = 5.5 — 6; G = 3.82 — 3.95.

Refractive indices: $_\epsilon$ = 2.493; $_\omega$ = 2.554.

Same reactions as rutile. Distinguished by form.

This dimorphic form of the oxide is much rarer than rutile, and is always found in minute crystals.

El Dorado County: Minute crystals with brookite were found implanted on quartz crystals near Placerville, Kunz[1], [2].

116. BROOKITE.

Oxide of titanium, TiO_2.

Orthorhombic. Crystals tabular or pyramidal. Color dark brown to black. Adamantine luster. H=5.5—6; G=3.87—4.01.

Refractive indices: $\alpha=2.583$; $\beta=2.586$; $\gamma=2.741$.

Same reactions as rutile. Distinguished by form.

This trimorphic form of the oxide is also much rarer than rutile, and only the one locality is known in the State for its occurrence.

El Dorado County: Found in tabular reddish brown crystals, with anatase on quartz crystals at Placerville. Forms by Penfield: (100), (001), (110), (210), (102), (104), (021), (121), (122), (134), (234), Kunz[1],[2].

117. CHRYSOBERYL.

Oxide of beryllium and aluminium, $BeAl_2O_4$.

Orthorhombic. Usually twinned crystals. Striated faces. Color grass-green, yellowish green and yellowish brown. Vitreous. H=8.5; G=3.5—3.84.

Refractive indices: $\alpha=1.747$; $\beta=1.748$; $\gamma=1.757$.

Infusible and insoluble. Fine powder, when intensely heated on charcoal, moistened with cobalt nitrate and re-heated, assumes a sky-blue color.

This is a very rare mineral and when of good color is important as a gem stone.

Butte County: Supposed green specimens of chrysoberyl have been found near Stanwood and at Big Bar. They are probably californite, which occurs in that vicinity.

118. HAUSMANNITE.

Oxide of manganese, Mn_3O_4.

Tetragonal. Small pyramidal crystals, massive, granular. Color brownish black. Streak chestnut-brown. Submetallic luster. H=5—5.5; G=4.72—4.85.

Refractive indices: $\epsilon=2.15$; $\omega=2.46$.

Infusible. Dissolves in hydrochloric acid, yielding chlorine gas. Borax bead is amethystine or wine-colored. Fused on platinum with sodium carbonate, gives deep blue-green fusion.

Manganese is abundant in the State, and it is quite possible that this rarer oxide may occur in many of the localities and remain unidentified.

Plumas County: Specimens of hausmannite have come from Meadow Valley.

Santa Clara County: Very abundant as crystals with the forms: (001), (113), (111) and (221) in the manganese boulder occurring near Alum Rock Park, five miles east of San Jose, Rogers[9].

119. MINIUM—Red Lead.

Oxide of lead, Pb_3O_4.

Powder. Color bright red mixed with yellow. Streak orange-yellow. G=4.6. Dull luster.

Refractive index: $n=2.40$.

Gives a yellow coating of lead oxide on charcoal and is reduced by sodium carbonate to metallic lead.

The red oxide of lead rarely is found native. It is an oxidation product of galena and other lead minerals, occurring as a powder.

Kern County: Specimens have come from near Fort Tejon.

Tulare County: A small amount of red lead was found in the northern part of the county.

120. CREDNERITE.

Oxide of manganese and copper, $Cu_3Mn_4O_9$.

Monoclinic. Foliated masses. Cleavage perfect basal. Color iron-black to steel-gray. Streak brownish black. Metallic luster. H=4—5; G=4.95.

Gives the manganese reactions like hausmannite and in addition a blue copper chloride flame when dipped in hydrochloric acid and heated in bunsen flame.

This is a very rare mineral and its occurrence in the State is limited to one locality.

Napa County: Found massive near Calistoga.

121. BRAUNITE.

Silico-oxide of manganese, $3Mn_2O_3.MnSiO_3$.

Tetragonal. Small pyramids and massive. Color brownish black. Streak brownish black. Submetallic luster. H=6—6.5; G=4.75.

Soluble in hydrochloric acid and leaves a residue of silica. Gives all the reactions for manganese similar to hausmannite.

Silicious manganese ores are very common in California, and it is probable that the rather common brown manganese exists in many of the localities, but it has never been reported.

Plumas County: Specimens of braunite have come from Meadow Valley.

122. PYROLUSITE.

Oxide of manganese, MnO_2.

Orthorhombic. Generally fibrous or as a powder. Color black. Streak dull-black. Metallic to dull luster. H=2—2.5; G=4.82.

Reactions like those for hausmannite and distinguished by crystallization and structure. Distinguished from manganite and psilomelane by not yielding water in a closed tube.

Pyrolusite is a very common mineral generally associated with other ores of manganese. It is usually found as fibrous seams and coatings

in masses of psilomelane, and often grades toward manganite. Common as dendritic coatings.

Alameda County: It occurs with psilomelane in the Diablo Range, southeast of Livermore in the Corral Hollow district. Occurs with psilomelane and sometimes rhodochrosite in deposits a few miles south of Tesla and along the Arroyo Mocha, southeast of Livermore.

Amador County: Found in the Seaton mine and on volcanic ash at Volcano. Pyrolusite occurs with psilomelane 1½ miles south of Volcano.

Calaveras County: Occurred at Wild Rose Flat near Murphy. Good specimens have come from San Andreas; also near Angels with psilomelane, and three miles northeast of Milton.

Colusa County: Found at Stonyford in association with cinnabar, and at the Manzanita mine.

Contra Costa County: Occurred with psilomelane on Red Rock, San Francisco Bay.

El Dorado County: In dendritic coatings near Placerville and fibrous at Greenwood. Masses occur at Greenwood and at Cool.

Humboldt County: Occurs with psilomelane at Alder Point; also on the Porter Ranch, Fort Baker.

Kern County: Fine specimens of pyrolusite with some psilomelane occur five miles west of Atolia.

Lake County: At the Phillips mine, near Laurel Dell with psilomelane.

Los Angeles County: Associated with psilomelane in small amounts at Banning.

Madera County: Occurs associated with limonite fourteen miles from Fresno Flat. Also near Coarse Gold with psilomelane, manganite, rhodochrosite and rhodonite.

Marin County: Small amounts found in the rock at Sausalito.

Mariposa County: Occurs with psilomelane at Jasper Point. Small masses occur in Hunters Valley.

Mendocino County: At Red Mountain. Occurs with the psilomelane at the Independence Manganese mine, Potter Valley. Near Covello; four miles west of Hopland with psilomelane; in the Potter Valley and Redwood Valley; near Willitts; at the Long mine, near Woodman Station; in chert at Westport; at the Cleveland mine, Ukiah.

Mono County: Some pyrolusite and psilomelane occur in the Bodie mines.

Napa County: Pyrolusite occurred as radiate concentric masses with cinnabar at the old Redington and Manhattan mines, Knoxville. Small amounts occur with psilomelane on Mt. St. Helena, and three miles west of Oakville.

Nevada County: Found in the Grass Valley district, Lindgren[6]. Also at Sweetland, and as dendrite on rocks of Sugar Loaf Hill.

Placer County: Occurs twelve miles from Auburn on Wolf Creek road.

Plumas County: Common in the Diadem lode, Meadow Valley district.

Riverside County: Occurs near Elsinore.

San Bernardino County: One of the minerals in the Calico and Barstow districts. Associated with psilomelane in the Emma and Owls Hole mines, in the Owl Mountains.

San Francisco County: It has been found in small amounts associated with psilomelane at Hunters Point.

San Joaquin County: In the manganese deposits of the Diablo Range.

San Luis Obispo County: The manganese deposits in the Prefumo Canyon on Stanench Ranch are pyrolusite and psilomelane.

San Mateo County: At Baden.

Santa Clara County: Found at the Washington mine and in mines of the Diablo Range.

Shasta County: Small amounts about sixteen miles northwest of Redding.

Sierra County: Common as dendrite at Alleghany.

Siskiyou County: Occurs with rhodonite at Sawyer's Bar.

Sonoma County: At the Shaw mine.

Stanislaus County: Psilomelane and soft botryoidal pyrolusite form the ore of the Seagrave mine; also at the Buckeye mine, Hospital Creek, with rhodochrosite.

Tehama County: Pyrolusite and psilomelane on the Luce prospect.

Tuolumne County: Common with psilomelane at Knapp's ranch, near Columbia.

HYDROUS OXIDES.

123. MANGANITE.

Hydrous oxide of manganese, $Mn_2O_3.H_2O$.

Orthorhombic. Crystals long prisms. Structure usually columnar. Perfect brachypinacoidal cleavage. Color iron-black. Metallic luster. Streak dark reddish brown. H=4; G=4.3.

Refractive indices: $\alpha = 2.24$; $\beta = 2.24$; $\gamma = 2.53$.

Yields the manganese reactions as given under hausmannite and a slight amount of water in a closed tube.

There are numerous small deposits of manganese in the State, and much of the ore appears to be manganite mixed with a more or less silicious psilomelane. The deposits consist generally of black porous ore in masses and lenses of red and brown jasper in the metamorphics of the Coast ranges, and to some extent in the Sierras. Reports on the deposits of the State have been made by Penrose[1] and by Harder[1].

Alameda County: Deposits occur in the Livermore-Tesla district southeast of Livermore in the Diablo Range. The ore is in jasper lenses, and much of the manganese produced in the State has come from this district along the Arroyo Mocha Creek.

Calaveras County: Some manganite with psilomelane occurs two miles northeast of San Andreas in mica schist.

Colusa County: Small deposits on the east flank of St. John Mountain, near Little Stony.

Contra Costa County: The deposits on Red Rock Island in San Francisco Bay contain some manganite with the psilomelane.

Kern County: The hydrous oxide manganite occurs with psilomelane in the Rand mining district near Randsburg.

Marin County: Some manganite is found in the red rock near Sausalito.

Mendocino County: At the Cave mine, ten miles northeast of Ukiah.

Placer County: Small pieces have been found near Colfax.

Plumas County: Considerable manganese occurs in this county in the Meadow Valley and other districts, and manganite is probably common.

Riverside County: Psilomelane and manganite occur in a network of veins in schist six miles northeast of Elsinore, in the Maria Mountains.

San Joaquin County: Some small deposits in jasper in the Diablo Range. The Ladd or Corral Hollow mine, southeast of Livermore, is the best known manganese mine in the State.

San Luis Obispo County: Small deposits occur five miles west of San Luis Obispo.

Santa Clara County: In the Black Wonder and other mines of the Diablo Range.

Sonoma County: At the Shaw mine eight miles northwest of Cloverdale.

Tuolumne County: Occurs with rhodonite two miles north of Sonora.

124. TURGITE.

Hydrous oxide of iron, $2Fe_2O_3.H_2O$.

Compact fibrous, botryoidal or earthy. Color red to reddish black. Streak red. Hardness of compact varieties = 5—6; G = 4.29—4.49.

Refractive indices: $\alpha = 2.45$; $\beta = 2.55$; $\gamma = 2.55$.

Flies to pieces when heated in a closed tube, which serves to distinguish it from hematite or limonite. Gives water in closed tube. Other reactions similar to hematite or limonite.

Turgite is a very common mineral in the State, since it is a hydrous hematite and may occur in hard masses or as ocher. It has seldom been differentiated from hematite, so our knowledge of distinct localities is deficient.

Inyo County: Reported to occur near Shoshone.

125. GÖTHITE.

Hydrous oxide of iron, $Fe_2O_3.H_2O$.

Orthorhombic. Slender prisms, vertically striated. Cleavage perfect brachypinacoidal. Color yellowish brown. Streak yellowish brown. Adamantine to submetallic luster. H = 5 — 5.5; G = 4.37.

Refractive indices: $\alpha = 2.26$; $\beta = 2.39$; $\gamma = 2.40$.

Distinguished from the more common limonite by its crystalline-fibrous and columnar structure and cleavage.

Göthite is usually found as slender prismatic crystals in masses of limonite or hematite, and resembles limonite so closely that it would be usually classed as such.

Inyo County: Found with chrysocolla and limonite at the St. Ignacio mine.

Mariposa County: Observed at Burns Creek in masses of limonite.

Riverside County: Göthite is associated with the other iron minerals of Eagle Mountains.

San Bernardino County: An associate with limonite at the magnetite-hematite deposit, near Dale.

126—LIMONITE—Brown Hematite.

Hydrous oxide of iron, $2Fe_2O_3.3H_2O$.

Massive. Compact, stalactitic, botryoidal, columnar, fibrous, earthy. Color yellow, brown to black. Streak yellowish brown. Submetallic to dull luster. H = 5 — 5.5; G = 3.6 — 4.

Refractive index: $n = 2.05$.

Distinguished from hematite by its streak and by its yielding water in a closed tube. Becomes magnetic on heating. Soluble in hydrochloric acid and brown ferric hydrate is precipitated by ammonia.

Limonite is the most common of the iron minerals, and is quite universal in its occurrence as a staining material. It is found varying from soft yellow and brown ocher to hard compact masses. As the common alteration product of pyrite and of most minerals containing iron, it is prevalent in most mineral districts and forms the gossan and brown capping of ore deposits. Cubes of limonite as pseudomorphs after pyrite are common in mining regions. As an ore of iron it is not so valuable as hematite or magnetite. It is present in every county in some form and only a few of its occurrences can consequently be cited.

Alameda County: Earthy limonite mixed with hematite is common as a gossan capping of the pyrite deposit at Leona Heights.

Amador County: Found in concretions and earthy masses at Pine Grove. With hematite and magnetite at Volcano.

Butte County: Large blocks at Burns Creek, W. P. Blake[9]. Thick masses at the Monarch mine; cubes at Red Hill and at Magalia.

Calaveras County: Forms capping of hill about one mile and a half north of Murphy. The Detert deposit near Valley Springs was formerly worked. Massive and yellow ocher at the Eureka mine, near Valley Springs. A deposit occurs 1½ miles northeast of Murphy, and also one seven miles southeast of Mokelumne Hill. Yellow and red ocher occurs at Campo Seco. A deposit occurs on Bonanza Creek, seven miles southeast of Mokelumne Hill. Massive limonite has come from the Dieffenbach Ranch, twenty-five miles northeast of Valley Spring. It is common in the vicinity of Campo Seco as ocher.

Colusa County: Yellow ocher occurs in a large outcrop 4½ miles west of Stonyford. Yellow and red ocher suitable for mineral paint occurs four miles south of Lodoga.

El Dorado County: Massive near Diamond Springs.

Inyo County: Pseudomorphs after long prisms of stibnite have been found at the Cerro Gordo mine.

Lake County: Ochers of yellow and brown shades occur two miles north of Hough Springs suitable for paint. Massive specimens have come from the hills near Glenbrook.

Mariposa County: Fine large cubes have come from the Chowchilla Valley.

Napa County: An ocher deposit occurs 1½ miles east of Calistoga.

Placer County: At Gold Run. Massive limonite occurs at the Clipper Gap mine.

Plumas County: Massive in Light's Canyon and at Nelson Point. Red and yellow ocher occurs near Quincy.

Riverside County: Yellow and brown limonite is common in the pisolitic cavities formed by the brucite, at Crestmore. Massive limonite occurs on the Eagle Mountains with some goethite.

Sacramento County: Yellow ocher occurs at Michigan Bar.

San Luis Obispo County: Brown banded masses have come from the Prefumo Ranch. This deposit lies in the Los Osos Mountains interbedded with Franciscan shales and sandstones and occurring with hematite. Dark brown massive limonite is found at the Harrington mine, four miles southwest of San Luis Obispo.

Shasta County: Common as cappings of the pyrite deposits of the county. Pseudomorphs after hedenbergite have been found at Ydalpan. Highly iridescent specimens have come from Copper City. Excellent bronze colored stalactites occurred at the Lost Confidence mine, Iron Mountain.

Sonoma County: Yellow ocher at the Occidental mine. Yellow ocher occurs on the Lancaster Ranch, east of Fisk's Mills.

Stanislaus County: A deposit of yellow ocher used for paint occurs at Knight's Ferry on the Stanislaus River.

Tulare County: Common in the Mineral King district.

Yolo County: In the sands at Capay.

127. BAUXITE.

Hydrous oxide of aluminium, $Al_2O_3.2H_2O$.

Massive, earthy, pisolitic. Color white, yellow, red or brown. H = 1.5; G = 2.55.

Refractive index: $\beta = 1.57$.

Infusible and insoluble. Moistened by a few drops of cobalt nitrate and intensely heated, the powder assumes a sky-blue color. Fused with sodium carbonate and the mass dissolved in hydrochloric acid, leaves no silica residue. Ammonia precipitates flocculent alumina hydrate from the solution. The absence of silica differentiates it from clay.

Bauxite has been reported from several localities in the State, but they are not authentic, and as yet only one deposit is known. The mineral closely resembles clay and is only distinguished at sight from clay by its characteristic pea-shaped, or pisolitic structure; that is, a structure having small round concretions of the mineral about the size of peas imbedded in the clay-like masses. Its color when pure is white, but the masses frequently are yellow, red and brown by impurities of the iron oxides.

Riverside County: Red and gray pisolitic bauxite occurs in a deposit between Corona and Alberhill. Analyses:

	Dark Red	Gray	Reddish
SiO_2	13.56	39.82	3.23
Al_2O_3	45.42	36.43	53.10
Fe_2O_3	14.87	7.14	12.82
MnO	0.05	0.04	----
TiO_2	2.34	2.37	1.65
H_2O at 105°	1.99	1.26	0.95
H_2O above 105°	23.23	13.96	29.08
	101.46	101.02	100.83

128. BRUCITE.

Hydrous oxide of magnesium, $MgO.H_2O$.

Hexagonal, rhombohedral. Foliated plates and fibrous masses. Cleavage perfect basal. Color white, gray, pink. Pearly luster. H = 2.5; G = 2.38 — 2.4.

Refractive indices: $\epsilon = 1.580$; $\omega = 1.559$.

Yields a small amount of water in a closed tube. Easily soluble in dilute hydrochloric acid and magnesia is precipitated by sodium phosphate. Gives a pink color characteristic of magnesia when intensely heated with cobalt nitrate.

Brucite occurs as thin veins in serpentine, but very little has been observed in the State as an alteration of serpentine. It also occurs as a metamorphic mineral in crystalline magnesian limestone.

Riverside County: Brucite is abundant in small globular masses in the white crystalline limestone at Crestmore, formed probably as a hydration product of original periclase. An analysis by Eakle gave:

MgO	Fe_2O_3	H_2O	
67.48	0.55	31.73	99.76 per cent

San Francisco County: A small amount of brucite has been observed as thin seams in the serpentines of San Francisco.

129. PYROCHROITE.

Hydrous oxide of manganese, $Mn(OH)_2$.

Rhombohedral. In hexagonal plates. Color white, but alters to brown and black. Pearly luster. H=2.5; G=3.258.

Refractive indices: ϵ=1.681; ω=1.723.

Heated in a closed tube, it becomes green, then black, and yields water. Gives green bead with sodium carbonate.

A rare manganese mineral only previously known to occur in this country at Franklin, New Jersey.

Santa Clara County: Occurred as a prominent constituent of a manganese boulder (supposed meteorite) near Alum Rock Park, five miles east of San Jose, Rogers[9].

130. SASSOLITE—Boracic Acid.

Hydrous oxide of boron, $B_2O_3.3H_2O$.

Triclinic. Usually in small scales. Cleavage perfect basal. Color white. Pearly luster. H=1; G=1.48.

Refractive indices: α=1.340; β=1.456; γ=1.459.

Soluble in water. Yellow turmeric paper when immersed in a hydrochloric acid solution and then dried, will assume a carmine red color. Fused in a colorless flame the mineral gives a momentary yellowish green flame. This flame and the turmeric paper reaction are characteristic of all borates.

The waters of some of the springs and lakes of the State contain traces of boracic acid, but the scaly white crystals of the solid sassolite have not been found.

Lake County: Occurs in the waters of Clear Lake, W. P. Blake[9].

San Bernardino County: Some of the borate waters of this county yield the oxide upon evaporation.

131. PSILOMELANE.

Hydrous oxide of manganese, usually impure.

Massive, botryoidal, stalactitic. Prominent conchoidal fracture. Color black. Streak brownish black. H = 5—6; G = 3.7—4.7.

Yields the manganese reactions as given under hausmannite, as well as water in a closed tube and precipitations of impurities, especially barium.

This is the most common manganese mineral and is the chief ore of manganese in the State. It is almost always associated with manganite or pyrolusite, and often with limonite. The mineral is found in many localities, but the characteristic occurrence of the more important deposits is in seams and irregular masses in jasper. All of the localities cited for pyrolusite and manganite contain psilomelane as well.

Wad is an impure soft black oxide, often with the harder psilomelane.

Asbolite is a wad containing cobalt.

Reports on the manganese deposits of the State have been made by Penrose[1] and by Harder[1].

Alameda County: The Corral Hollow deposit is largely silicious psilomelane. The manganese deposits lie a few miles southeast of Livermore along the Arroyo Mocho and south of Tesla, in what is known as the Corral Hollow district, which extends into San Joaquin County. Psilomelane is the chief mineral, associated with pyrolusite and occasionally rhodochrosite.

Amador County: A deposit of psilomelane mixed with pyrolusite occurs 1½ miles south of Volcano. Also one four miles east of Pine Grove and another about one-half mile southeast of Defender.

Butte County: Psilomelane occurs in several localities in the immediate vicinity of Clipper Mills.

Calaveras County: Deposits of psilomelane occur three miles northeast of Milton, associated with pyrolusite; two miles northeast of San Andreas; six miles southeast of Valley Springs.

Colusa County: Psilomelane in small amounts occurs on eastern slope of St. Johns Mountain, west of Stonyford.

Contra Costa County: The deposit of manganese on Red Rock, San Francisco Bay, which was formerly mined, is psilomelane.

Fresno County: Some psilomelane occurs near Piedra on Pine Flat.

Glenn County: Associated with pyrolusite at the Black Diamond and Rattlesnake mines, about thirty miles southwest of Fruto. Some silicious psilomelane is reported from Millsaps.

Humboldt County: Occurs with pyrolusite on the Porter Ranch, Fort Baker, in good massive ore.

Imperial County: Psilomelane deposits have been reported in the Chocolate Mountains.

Inyo County: Fine specimens found at southeast end of Panamint Range, twenty-five miles south of Bennett's wells on Death Valley slope.

Lake County: Small amounts of good ore come from the vicinity of Glenbrook. Psilomelane occurs on the Phillips Ranch about 1½ miles south of Laurel Dell, and on Dry Creek about three miles west of Middletown. A large deposit occurs about ten miles north of Upper Lake and thirty-eight miles northeast of Ukiah on the southwest slope of Horse Mountains. The manganese ore of the Smythe manganese prospect is mainly psilomelane with some pyrolusite.

Los Angeles County: Asbolite occurred in the O K mine, San Gabriel Canyon. Deposits occur about five miles west of Palmdale, of silicious psilomelane.

Marin County: Small streaks and pockets of psilomelane occur near Sausalito and Fort Baker and in masses on the Mallard Ranch, about eight miles northwest of San Rafael.

Mariposa County: Small masses occur in Hunters Valley.

Mendocino County: Large deposits in Potter Valley. Reported on the Pieta Creek near Pieta in large amounts. Deposits occur at the Cleveland mine three miles east of Calpella; and at the Independent mine fourteen miles east of Willits. Occurs in the hills east of Middle Fork of the Eel River. Associated with rhodochrosite on Mount Sanhedrin. A deposit of high grade occurs on Shaw Ranch, seven miles northwest of Cloverdale. The Thomas and Wild Devil mines, about six miles northeast of Redwood Station, contain psilomelane in jasper.

Merced County: Manganese deposits occur in the southwestern corner of the county, about twenty-six miles east of Tres Pinos.

Monterey County: Deposit occurs about three miles north of the mouth of San Carpojaro Creek and one mile inland. Occurs in the Chalone district near Soledad.

Napa County: Deposit five miles west of Oakville and another six miles northeast of St. Helena. Small amounts of manganese minerals occur on Mt. St. Helena and on Moore Creek. Also three miles west of Oakville.

Nevada County: Wad occurs near the North Banner mine. Psilomelane occurs near west bank of Bear River, seven miles from Colfax. A large body occurs in the Limekiln district, northwest part of county.

Placer County: Masses at Michigan Bluff. Deposits occur about nine miles north of Colfax near Yankee Jim.

Plumas County: Large masses on Mumford Hill. Psilomelane, manganite and rhodonite occur in the Diadem and Penrose Lodes, near Edmanton, in the Meadow Valley district. Deposits occur near Crescent Mills.

Riverside County: Deposits occur in the McCoy Mountains about twelve miles northwest of Mineral Station. Occurs about seven miles southwest of Perris interbedded with jasper. Black massive psilo-

melane occurs in the Palen Mountains about twenty-two miles northwest of Mineral. Some occurs about six miles northeast of Elsinore associated with rhodonite. At the base of the Santa Maria Mountains. Some occurs about eight miles northwest of Palo Verde.

San Benito County: Stringers and coatings occur with the benitoite of this county, Louderback[2]. Occurs in cherts about eighteen miles east of Tres Pinos on Fries and Lewis ranches.

San Bernardino County: Occurs on the north slope of Avawatz Mountains; at the Owls Hole mine, Owl Mountain; on the Lavic Mountains, five miles northwest of Ludlow, associated with pyrolusite. Good specimens have come from Wagner, Mojave Desert.

San Diego County: Fine specimens have come from Winchester and from Campo.

San Joaquin County: In the manganese deposits of the Diablo Range, notably at the Ladd mine in Corral Hollow.

Santa Clara County: The outer crust of the manganese boulder near Alum Rock Park, five miles east of San Jose, was the black oxide, psilomelane, Rogers[9].

Shasta County: A deposit of psilomelane occurs on Pitt River, one mile south of Herault. Occurs with jasper in Arbuckle Mountain.

Siskiyou County: Occurs in small amounts with pyrolusite near Fort Jones.

Sonoma County: Deposit near Freestone.

Stanislaus County: Occurs on Porter Creek west of Patterson. In the manganese deposits of the Diablo Range, notably at the Buckeye mine, west of Vernalis.

Tehama County: Deposits occur with jasper on Beauty View Butte, ten miles west of Paskenta.

Tuolumne County: Massive with pyrolusite near Columbia.

CHAPTER VII.

CARBONATES.

Anhydrous.
Calcite
Dolomite
Ankerite
Magnesite
Siderite
Rhodochrosite
Smithsonite
Aragonite
Strontianite
Witherite
Bismutosphaerite
Phosgenite
Northupite
Tychite
Hydrous.
Malachite
Azurite
Anrichalcite
Hydrozincite
Dawsonite
Thermonatrite
Gay Lussite
Natron
Trona
Pirssonite
Hydromagnesite
Hydrodolomite
Zaratite
Bismutite

ANHYDROUS CARBONATES.

132. CALCITE—Calc Spar—Limestone.

Carbonate of calcium, $CaCO_3$.

Hexagonal, rhombohedral. Crystals common, rhombohedrons and scalenohedrons. Also massive, granular, stalactitic, chalky. Cleavage perfect rhombohedral. Colorless, white, yellow, brown, blue, red, pink, green, black, etc. Vitreous luster. H=3; G=2.71.

Refractive indices: ϵ=1.486; ω=1.658.

The carbonates are all characterized by their effervescence with hydrochloric or nitric acids. Calcite effervesces freely in very dilute acid and gives a flame test that is bright red at first, fading into a yellow red. The calcium can be precipitated by ammonium oxalate as a white granular calcium oxalate.

Calcite is one of the exceedingly common minerals and occurs in many colors and in many varieties based on color and structure. Some of these varietal names are: *iceland spar, dogtooth spar, stalactite, stalagmite, marble, onyx marble, travertine, calc-tufa, chalk* and common limestone. Extensive beds of limestone are common in the State, and are quarried for the manufacture of cement. Fine quality marble is also known, but much of it is quarried for cement.

Manganocalcite is a variety containing manganese. It weathers black.

Alameda County: Crystals are common in the chalcedony geodes on the Berkeley Hills. A fine grade of lithographic limestone on the Crocker-Winship properties, south of Danville. Crystals of calcite and massive limestone near Sunol.

Alpine County: Fine groups of rhombohedrons have come from the Pennsylvania mine.

Amador County: Light gray and bluish marble occurs 2½ miles east of Plymouth in Dry Creek Canyon.

Butte County: A black mottled marble is found at Pentz. On West Feather River, a few miles west of Yankee Hill; white and bluish

crystallized limestone at the Big Bend of North Fork Feather River near Intake Station.

Calaveras County: Crystals occur near Natural Bridge. Fine stalactites occur in Mercer's Cave, 1¼ miles northwest of Murphy. Good marble occurs near Murphy and near San Andreas. White and variegated marble occurs about 1¼ miles east of San Andreas, also about four miles southeast of Valley Springs.

El Dorado County: Fine stalactites occur at the Alabaster Cave. Good crystals found at the Cosumnes copper mine. Large cleavage rhombohedrons occur in the Starlight mine, three miles south of Mud Springs.

Fresno County: Good marble in various colors, white, blue, black, and variegated occurs on the south side of Big Creek, five miles below Caseada.

Glenn County: Banded marble on the Nye Ranch and on east side of Stony Creek.

Imperial County: Large deposit of crystalline limestone or marble on the south side of Coyote Mountain:

Analysis:

$CaCO_3$	96.6
$MgCO_3$	1.7
SiO_2	tr.
Al_2O_3, Fe_2O_3	0.9
$CaSO_4$	0.5
	99.7

Good variegated marble occurs at the Fowler Quarry, Coyote Mountains.

Inyo County: Thick deposits of beautiful variegated marble occur at the foot of the Inyo Mountains, between Keeler and Lone Pine. The marble is dolomitic. Fine crystal specimens and stalactites have been found at the Cerro Gordo and Union mines. Gray, greenish and yellow marble found at the Lindsay quarries, Walker River; fine crystals at the Lane mine.

Kern County: Large deposit of crystalline limestone occurs three miles south of Tehachapi, near Neenach. Blue rhombohedrons in Grizzly Canyon, three miles southwest of Tehachapi.

Lake County: Small body of crystalline limestone near Hullville.

Los Angeles County: Calcite crystals occur with the colemanite at Lang with the forms: $(10\bar{1}0)$, $(01\bar{1}2)$, $(09\bar{9}5)$, $(02\bar{2}1)$, (0001). White marble occurs in Antelope Valley; also in Pacorima Canyon near San Fernando.

Marin County: Low thin-edged rhombohedrons of manganocalcite occur in a trachite on the Burdell Ranch. They turn black when heated and also by weathering.

Mariposa County: Good crystals have come from the mines near Mariposa. Large deposit of white marble containing dark streaks occurs on South Fork of Merced River. Calcite crystals occur with quartz and arsenopyrite at the Smith mine, Bear Valley.

Merced County: A strontian-bearing calcite is said to occur at Delhi.

Modoc County: Small stalactites occur on South Fork of Pitt River.

Mono County: A large deposit of travertine occurs near Bridgeport. Good crystals have come from the Bodie district. A mass of white marble occurs in canyon southeast of Topaz.

Monterey County: Large perfect crystals occur near Soledad. Deposit of limestone near Natividad, 9½ miles from Salinas.

Napa County: Onyx marble has come from a place called Zem Zem near Knoxville.

Nevada County: Common in the Grass Valley and Nevada City mines. Fine scalenohedrons have come from the Pittsburg mine. Found northeast of Nevada City on banks of South Yuba River. Calcite crystals occur with kämmererite at the Red Ledge mine, near Washington.

Orange County: Greenish and white marble occur in Cool Canyon on west side of Mt. Downey, Santa Ana Range. Fossiliferous beds occur near El Toro.

Placer County: One of the minerals of the Ophir district, Lindgren[5]. A verd-antique variety was found about sixteen miles northeast of Auburn. Verd-antique marble reported near Butcher Ranch; white marble near Hotaling.

Plumas County: Large divergent masses of calcite in the Genessee Valley. Marble occurs on sides of Middle Feather River.

Riverside County: Blue calcite occurs at Crestmore, which is quarried for cement manufacture. Ophicalcite is found on the Eagle Mountains.

San Benito County: Found in the rocks adjoining the benitoite veins near the headwaters of the San Benito River, Louderback[2].

San Bernardino County: A large deposit of beautiful variegated marble occurs at the Gem Marble quarries in the Silver Mountain district about five miles south of Oro Grande which is now quarried for cement. Also on Slover Mountain, near Colton, gray limestone is quarried for cement. Large calcite cleavage masses with black carbonaceous matter arranged zonally, and twinned on the -½R face, occur six miles northwest of Ludlow. Verd-antique marble on Mojave Desert about sixteen miles from Victorville. Large deposit of white, pink and blue near Baxter. Iceland spar occurs in Cave Canyon district, near Yermo.

San Diego County: White and gray banded marble on Los Penasquitas Creek. Dark gray marble near Jacumba; large bed of white speckled marble 4½ miles northeast of Dos Cabezas Springs.

San Francisco County: Scalenohedrons of calcite occur at Fort Point. They have the forms: $(53\bar{8}2)$, $(23\bar{5}8)$, $(4.16.\bar{2}0.3)$, $(1.6.\bar{7}.13)$, Schaller[8].

San Luis Obispo County: Beautiful onyx marble with moss-like inclusions of greenish chlorite imparting a landscape effect to the translucent thin slabs occurs at the Kesseler deposit, about seventeen miles northeast of Arroyo Grande.

San Mateo County: Crystals have come from near San Pedro. Occurs as crystalline veins in limestone at Montara.

Santa Barbara County: Pink rhombohedrons found on Santa Catalina Island.

Santa Clara County: Yellow, white and brown marble five miles southeast of New Almaden.

Santa Cruz County: Large masses on Ben Lomond, west of Felton. Coarsely crystalline limestone on northwest side of San Felipe Canyon, northwest of Santa Cruz; also one mile from Santa Cruz.

Shasta County: Large stalactites and tubular shapes occur in Potter's Cave, near Baird. Eakle[6]. Marble deposit reported five miles east of Kennett.

Siskiyou County: Large deposits of white and variegated marble occur on Marble Mountain.

Solano County: Onyx marble and massive limestone occurs near Tolenas. A brown banded onyx marble occurred near Suisun.

Sonoma County: Low rhombohedrons of calcite occur in geodes near Petaluma.

Trinity County: Calcite occurs with garnet and epidote at Red Mountain.

Tulare County: Dark gray marble on James Ranch, eight miles southeast of Porterville.

Tuolumne County: White and blue-veined marble occurs in an extensive deposit on the Stanislaus River a few miles north of Columbia. Fine crystals with the forms $(10\bar{1}0)$, $(01\bar{1}1)$, and $(3\bar{1}\bar{2}1)$ were found at the Keltz mine. Large stalactites at the Crystal Palace Cave near Columbia. The marble quarries three miles northwest of Columbia on Stanislaus River are well known in the State.

Yuba County: Marble on north and south side of Yuba River, and on Oregon Creek.

133. DOLOMITE—Magnesium Limestone.

Carbonate of magnesium and calcium (Ca,Mg) CO_3.

Hexagonal, rhombohedral. Crystals usually with curved faces and massive. Cleavage perfect rhombohedral. Color white, gray, brown, pink. H=3.5—4; G=2.88.

Refractive indices: ϵ=1.500; ω=1.681.

Effervesces feebly in cold dilute acids. Best distinguished from calcite in the wet way. After removal of the calcium by its precipitation with ammonium oxalate, the magnesium is obtained from the filtered solution by precipitating with sodium phosphate.

Dolomite is a common mineral, but is not so abundant as calcite. Much of the limestone and marble of the State is dolomitic, and some is doubtless pure dolomite, but the amount and localities are unknown since the two carbonates are only chemically differentiated. The mineral is commonly associated with magnesian silicates, especially the serpentine rocks, in which it is often found as white veins.

Alameda County: Some dolomite occurs in the manganese district about fifteen miles southeast of Livermore.

Calaveras County: White crystals of dolomite occurred in the gold-bearing schist of Carson Hill.

El Dorado County: A large vein occurs at the Laskin mine, one-half mile east of Diamond Springs.

Inyo County: The variegated and white marbles of the Inyo Mountains are dolomitic. Good crystals were found in the San Felipe mine. A commercial body occurs at the Bodgley quarry, four miles north of Keeler.

Monterey County: Occurs at Natividad. Large deposit of dolomite occurs lying along the foothills six miles east of Salinas.

Nevada County: Dolomite occurs as veins in the serpentine at Nevada City.

Orange County: A mass of dolomite with gypsum occurs in Gypsum Canyon, west slope of Santa Ana Range.

Plumas County: Silicious dolomite is common in the Diadem Lode.

Riverside County: Dolomite in a variety of colors occurs on the Eagle Mountains.

San Benito County: Pure white dolomite is found in a large body about ten miles southwest of Hollister. Massive dolomite occurs west and southwest of Hollister. Crystals occur at Sampson Magnesite mine near New Idria.

San Bernardino County: Massive near Victorville, associated with bodies of calcite.

San Luis Obispo County: A vein of white dolomite occurs in Little Falls Canyon.

Santa Clara County: Large specimens of drusy crystallizations and low rhombohedrons of snow-white dolomite occurred in the New Almaden and Guadalupe quicksilver mines.

Tuolumne County: Dolomite is a common associate of the mariposite schists of the mines near Jamestown. Part of the limestone near Sonora is dolomite.

134. ANKERITE.

Carbonate of calcium, magnesium and iron, $CaCO_3.MgCO_3.FeCO_3$.

Hexagonal, rhombohedral. Generally massive. Cleavage like calcite. Color white to brown. H = 3.5 — 4; G = 2.95 — 3.1.

Refractive indices: $\epsilon = 1.526$; $\omega = 1.716$.

Becomes magnetic on heating. The presence of the three bases, iron, calcium and magnesium, is determined by their precipitation from the acid solution with ammonia, amonium oxalate and sodium phosphate in the order given.

Ankerite is sometimes classed as an iron-bearing dolomite. It is a very common form of carbonate associated with the gold-bearing schists of the Mother Lode region, especially with the green mica, mariposite.

Calaveras County: Occurs in the schists at the Golden Gate mine.

Mariposa County: The mineral was first reported by Silliman[5] as an associate of mariposite on the Mariposa Estate. It was prominent in mariposite schists at the Josephine mine.

Tuolumne County: Common on Quartz Mountain and at the Rawhide ranch mine, near Tuttletown. Reported from the Eagle Shawmut mine on Woods Creek.

135. MAGNESITE.

Carbonate of magnesia, $MgCO_3$.

Hexagonal, rhombohedral. Crystals are rare. Generally compact massive; sometimes earthy. Color snow-white to brown. Prominent conchoidal fracture, of massive mineral. H = 3.5 — 4.5; G = 3.0 — 3.12.

Refractive indices: $\epsilon = 1.509$; $\omega = 1.700$.

Cold dilute hydrochloric acid has little effect, but when heated it effervesces freely. The solution, when treated by ammonia, ammonium oxalate and sodium phosphate, will give an important precipitate only when the last reagent is used. Magnesite moistened with cobalt nitrate and intensely heated, will turn pink.

Magnesite is a very common mineral in California because of the great areas of serpentine from which it is an alteration product. It is characteristic of the serpentinized rock to be intersected by veins and patches of the snow-white to light buff carbonate, some of these veins forming important deposits of the mineral. The main deposits lie in the serpentine belts of the Coast Ranges, but minor deposits also occur in the serpentines of the Sierras. The mineral is almost uniformly in

cryptocrystalline masses with prominent conchoidal fracture, and the silicious varieties are very hard. A bulletin on the magnesite deposits of the State has been issued by Hess[2] who gives the analyses cited below.

Alameda County: Small veins occur in the serpentine on Cedar Mountain, about twenty-two miles southeast of Livermore. Stray boulders found on Hoyle's Ranch, eleven miles southeast of Livermore.

Calaveras County: Veins occur near San Andreas.

Fresno County: A very pure magnesite occurs in veins on Kings River at Piedra, nine miles east of Sanger. Deposits at Piedra and Watt Valley, latter showing peculiar surface jointage cracks.

Kern County: Some veins are found near Walker's Pass, east of Bakersfield. A sedimentary bedded deposit interstratified with clay and clay shales occurs about three-quarters mile north of Bissell Station, eleven miles east of Mojave, Gale.[7]

Kings County: Occurs in southwest corner of county near Parkfield.

Los Angeles County: A small deposit occurs in serpentine on a branch of San Francisquito Canyon.

Mendocino County: Pure white veins on Hixon ranch, about twelve miles north of Cloverdale.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.41	0.28	0.12	0.03	47.16	51.88	=99.88 per cent

Deposit six miles north of Healdsburg. A deposit fifteen miles northwest of Cloverdale.

Modoc County: Specimens have come from near Adin.

Monterey County: Found three miles east of Parkfield.

Napa County: A large number of veins occur in the serpentine of the county. Very prominent in Chiles Valley, about thirteen miles from Rutherford. Analyses of the mineral from this locality gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	H_2O	
2.15	1.22	1.16	5.28	41.01	48.72	--	= 99.54 per cent
1.81	0.08		tr.	46.55	51.25	0.32	=100.01
6.68	15.10	--	--	37.20	40.98	--	= 99.96

Veins also occur on the east side of Pope Valley, in Soda Creek Canyon, and in the serpentine of Berryessa Valley. Magnesite is one of the most important minerals of the county. The deposits are mainly in Pope and Chiles Valleys. Large deposit of yellowish brown limonitic magnesite in the White Rock deposit.

Nevada County: Narrow veins occur in the serpentine at Nevada City.

Placer County: Veins occur near Damascus and Michigan Bluff and at Gold Run. Deposits occur about five miles northeast of Iowa Hill, and near Towle.

Riverside County: Veins are found in a hill of serpentine, about three miles south of Winchester, which are worked for cement purposes.

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
4.73	0.12	0.08	0.43	44.77	49.40	=99.53 per cent

San Benito County: Large deposits on west slope of Sampson Peak, three miles southwest of New Idria. Some of the magnesite at Sampson mine is coated with dolomite.

San Bernardino County: Occurs in the Quaker Group, four miles south of Cima. The mineral has been observed near Needles.

San Francisco County: Small veins occur in the serpentine at Fort Point.

San Luis Obispo County: Small veins on the Kiser ranch about nine miles northwest of Cambria.

Santa Barbara County: Some veins exist in the mountains back of Santa Barbara.

Santa Clara County: Large veins exist in the Diablo Range in the northeast corner of the county. An analysis of quite pure magnesite from the Alameda claim gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.73	0.14	0.21	0.40	46.61	51.52	=99.61 per cent

An analysis of buff-colored silicious magnesite from the Cochrane ranch, about four miles from Morgan Hill Station, gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
49.85	3.45	0.18	0.48	21.53	23.96	=99.45 per cent

Analysis of the mineral from veins in serpentine near Coyote gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
0.30	0.16	0.38	1.34	45.86	51.80	=99.74 per cent

The mineral occurs prominently at the Madrone Magnesite mine, near Madrone.

Sonoma County: There are numerous veins in the serpentine of the county, and Hess gives several analyses. 1. Veins near Preston called the Kelling deposit contain an isomorphous mixture of siderite; 2. Verdi Ranch, near Cloverdale; 3. Gillam Creek deposit on steep west side of creek, about seven miles northwest of Guerneville; 4. Red Slide deposit in valley of East Austin Creek, about eight miles north of Cazadero.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
1.	1.60	0.25	1.09	1.04	45.20	50.43	=99.61 per cent
2.	0.51	1.98	0.16	0.59	45.84	50.80	=99.88
	0.23	0.04	0.20	0.19	46.88	51.57	=99.11
3.	3.51	1.10	0.80	1.46	43.65	49.16	=99.68
4.	7.67	0.26	0.29	0.04	48.42	48.08	=99.76

Stanislaus County: The veins of the American Magnesite Company extend across the line from Santa Clara County. Occurs in the southwest corner of this county. High grade from the Quinto mining claim.

Tulare County: A large amount of magnesite has been mined from veins on hills about four miles northeast of Porterville. Hess gives several analyses of the mineral from this county. 1. From the serpentine hills near the chrysoprase locality, about eight miles southeast of Porterville; 2. On range of hills about four miles northeast of Porterville; 3. From veins on South Fork of Tule River.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	
1.	0.31	0.11	0.08	0.24	47.22	51.64	=99.60 per cent
2.	2.28	0.03	0.26	1.32	45.17	50.74	=99.80
	0.90	0.49		1.49	44.39	50.06	
3.	0.80	0.42	0.20	1.02	45.94	51.30	=99.68

Small veins also occur in Round Valley, about four miles east of Lindsay; on Rocky Hill, about two miles east of Exeter, with californite; near Naranjo with white opal; and near Auckland. Deposit at the Alpha claim 3½ miles east of Strathmore of high grade. White River deposits five miles west of Tailholt.

136. SIDERITE—Spathic Ore.

Carbonate of iron, $FeCO_3$

Hexagonal, rhombohedral. Crystals with curved faces, also massive. Cleavage perfect rhombohedral. Color ash-gray to dark brown. Vitreous to pearly luster. H=3.5—4; G=3.8.

Refractive indices: ϵ=1.633; ω=1.875.

Effervesces only in hot hydrochloric acid. Becomes magnetic on heating.

The iron carbonate is occasionally found in the mining regions in drusy crystallizations associated with pyrite and galena, but the mineral does not appear to be very common in the State.

Calaveras County: Occurs with albite, calcite and quartz at Campo Seco.

El Dorado County: Occurs with calcite and albite at the Red Hill mine, Kelsey mining district.

Imperial County: Occurs with specular hematite in quartz, near Bard.

Inyo County: Small masses have been found at the Custer mine, Coso district.

Los Angeles County: Some massive siderite occurs in the Tejunga Canyon.

Mariposa County: Found with calcite at Devils Gulch.

Mono County: Occurs with limonite and hematite near Benton.

Plumas County: A common carbonate associated with the copper minerals of the Engels mine.

Santa Clara County: A deposit occurs on the Weber Ranch, in Los Animos Hills, three miles northeast of Madrone; large masses on Red Mountain; on Coyote Creek 4½ miles east of Madrone; small irregular bunches three miles east of Coyote on west slope of Metcalf Canyon.

Shasta County: According to Fairbanks[2] siderite occurs in large masses in this county east of the Stillwater region.

137. RHODOCHROSITE.

Carbonate of manganese. $MnCO_3$.

Hexagonal, rhombohedral. Small crystals and massive. Cleavage perfect rhombohedral. Color rose-red or gray. Vitreous luster. H=3.5—4.5; G=3.45—3.60.

Refractive indices: ϵ=1.597; ω=1.817.

Its effervescences and wine or amethystine bead with borax serve to distinguish it.

Few good specimens of the rose-red carbonate have been found in the State. The mineral is generally found in gold-silver regions where manganese is associated with the veins.

In many of the manganese deposits of the State the gray carbonate is quite abundant as the primary mineral.

Alameda County: Rhodochrosite, both gray and pink, occurs commonly in the psilomelane mines of the Tesla district, southeast of Livermore. Occurs on the Arroyo Mocho road southeast of Livermore, with the black oxide of manganese. Found at the Merchant mine nine miles southeast of Livermore.

Amador County: Occurs with black manganese oxides two miles east of Pine Grove.

Butte County: The mineral has been found on the North Fork of the Feather River.

Madera County: Occurs near Coarse Gold with manganese minerals.

Mariposa County: In Indian Gulch gray and red rhodochrosite is associated with psilomelane.

Mendocino County: In Mt. Sanhedron Group at Impassable Rock.

Placer County: Small druses of the mineral have been found in some of the mines of the county.

San Bernardino County: Good specimens occur at the New York mine near Manvel. Reported as a vein mineral in quartz at the Sagamore mine, New York Mountains.

San Joaquin County: In the Ladd mine of Corral Hollow.

Santa Clara County: Occurred as pink crystals showing steep negative rhombohedron $(02\bar{2}1)$ with occasionally the unit rhombohedron $(10\bar{1}1)$, in the manganese boulder near Alum Rock Park, five miles east of San Jose, Rogers[9].

Stanislaus County: With calcite and pyrolusite in the Buckeye Manganese mine, Hospital Creek.

138. SMITHSONITE—Dry Bone.

Carbonate of zinc, $ZnCO_3$.

Hexagonal, rhombohedral. Drusy crystals and massive; often bone-like. Color grayish, bluish, greenish. Vitreous luster. H=5; G=4.45.

Refractive indices: ϵ=1.618; ω=1.818.

Effervesces readily in hydrochloric acid. Fused with sodium carbonate on charcoal, becomes yellow while hot and white when cold. Moistened with cobalt nitrate and intensely heated, assumes the yellowish-green color, characteristic of zinc minerals.

Smithsonite is a secondary mineral more often found in silver-lead districts. It is usually associated with lead carbonate and the silicates of zinc.

Inyo County: Found with cerussite at the Modoc mine, Cerro Gordo, Hanks[6]. Present also at the Ignacio mine with calamine and willemite. An unusual stalactite form of the zinc carbonate occurs at Cerro Gordo. Occurs with calamine at Camp Burgess. Found in the limestone footwall of Cerro Gordo mine. With cerussite and galena in limestone at Redwing and Noonday mines, Resting Springs district. Common at the Minneatta mine. Occurs with galena and cerussite in limestone at the Ophir mine.

Kern County: Occurred in drusy veins at the Jewett mine on Cottonwood Creek.

San Bernardino County: With calamine at the Cuticura mine, near Daggett. Occurs with cerussite, anglesite, linarite and galena in dolomite at the Ibex mine, Black Mountains, six miles north of Saratoga Springs. Found at the Ophir mine, Slate Range.

139. ARAGONITE.

Carbonate of calcium, $CaCO_3$.

Orthorhombic. Slender prisms, acicular, fibrous, stalactitic, massive. Colorless, white, yellow, brown. Vitreous luster. H=3.5—4; G=2.93—2.95.

Refractive indices: α=1.531; β=1.682; γ=1.686.

Distinguished from calcite by its action with cobalt nitrate. The powder boiled in a solution of cobalt nitrate, turns violet and the solution also assumes this color. Whereas calcite has no effect on the solution. Other reactions the same as for calcite.

The distinction between calcite and aragonite has seldom been made, and much of the banded onyx marble of the State has been erroneously called aragonite. The fine snow-white branching stalactitic form of aragonite, called "*flos ferri*," is exceptional in its occurrence in the State.

Calaveras County: Fine stalactites of "flos ferri" have come from a cave near Murphy. Fine masses have been found in the Morgan mine, Carson Hill.

Colusa County: Found with sulphur at Sulphur Creek. A beautiful banded dark brown onyx marble occurs near Sulphur Creek. Masses have come from the Candace mine.

Placer County: Said to occur at Gold Run.

Riverside County: Small amounts of fibrous aragonite were found at Crestmore.

San Benito County: Occurs in the rocks adjoining the benitoite veins as radiate bunches and stringers near the headwaters of the San Benito River, Louderback[2].

San Bernardino County: Said to have occurred with priceite, Silliman[8], probably from Calico. Occurs with calcite in the limestone of Slover Mountains near Colton.

San Francisco County: Found as thin veins in the serpentine of Fort Point, Eakle[1].

Solano County: Some aragonite is formed at the Tolenas Springs.

Tuolumne County: Occurs as bunches in the basaltic rock of Table Mountain.

140. STRONTIANITE.

Carbonate of strontium, $SrCO_3$.

Orthorhombic. Columnar masses, fibrous, granular. Cleavage prismatic. Color white, pale green, yellowish. Vitreous luster. H=3.5—4; G=3.68—3.71.

Refractive indices: $\alpha = 1.520$; $\beta = 1.667$; $\gamma = 1.667$.

Effervesces like calcite. Distinguished from calcite by its permanent deep crimson flame obtained by taking a little of the powder on a platinum wire moistened with hydrochloric acid and holding it in a colorless Bunsen flame. Also by its sulphate being more insoluble than calcium sulphate.

The strontia compounds are of recent discovery in the State, and the carbonate has been found in several localities.

Inyo County: A deposit of brown massive strontian carbonate occurs three miles west of Shoshone.

Plumas County: Large masses of divergent columnar strontianite were found in the Genessee Valley.

San Bernardino County: Large deposits occur as brown fibrous and gray granular masses in limestone on Mud Hills, or Strontium Hills, ten miles north of Barstow. Some celestite and gypsum are associated. The deposit has been described by Knopf[4].

141. WITHERITE.

Carbonate of barium, $BaCO_3$.

Orthorhombic. Seldom in good crystals. Usually columnar or granular. Poor cleavage. Color white or gray. H=3—3.75; G=4.27.

Refractive indices: $\alpha=1.529$; $\beta=1.676$; $\gamma=1.677$.

Infusible. Gives alkaline reaction on turmeric paper. Easily soluble with effervescence in hydrochloric acid. On adding sulphuric acid, barium sulphate is precipitated. Gives green flame of barium.

Sometimes found associated with barite, but it is very rare in this country.

Mariposa County: Massive witherite occurs with barite in the deposit near El Portal. This is the only commercial deposit known in the United States.

Shasta County: On Beegum Creek, near Platina. Massive.

142. CERUSSITE.

Carbonate of lead, $PbCO_3$.

Orthorhombic. Platy crystals. Generally massive. Color gray, cream-white, brown. Adamantine to vitreous luster. H=3 — 3.5; G=6.46 — 6.57.

Refractive indices: $\alpha=1.804$; $\beta=2.076$; $\gamma=2.078$.

Soluble in nitric acid with effervescence. Easily fusible. Fused on charcoal with sodium carbonate, reduces to metallic globules of lead and gives yellow coating.

The carbonate of lead is a common alteration product of galena, and in all mines carrying much lead sulphide it is to be found in the oxidized portion of the veins. It generally occurs as heavy gray or brown masses, but is occasionally found in cream-white platy crystals in the porous ore and galena cavities. In silver districts it is frequently rich in silver and forms the chief ore.

Imperial County: Occurs in small veins and pockets five miles east of Picacho.

Inyo County: Large crystals were found in the Russ district, W. P. Blake[9]. A common mineral in the Cerro Gordo and other silver districts of the county. With galena at the Montezuma mine, ten miles southeast of Big Pine; with galena and smithsonite in limestone at the Ophir mine, Slate Range; at the Redwing mine with smithsonite; at the Santa Rosa mine, Lee district; with smithsonite in limestone at the Ventura mine; common in the Carbonate mine; with galena and smithsonite at the Noonday mine; large crystals with anglesite at the Ubehebe mine; occurs with galena, chalcopyrite and native copper in limestone at Chloride Cliff, Grapevine Range.

Kern County: With galena seven miles northwest of Randsburg.

Mono County: Common in the Blind Springs district, Goodyear[1].

Riverside County: Occurs with galena in gold-bearing quartz at the Free Coinage and Steel mines, Hodges district, in southeast corner of

county. The lead carbonate occurs in very small amounts as an alteration of galena at Crestmore.

San Bernardino County: In the hornsilver districts of Calico and Barstow the lead carbonate was a very prominent mineral, Lindgren[1], Storms[1]. Very prominent in the Silver Reef district near Oro Grande. Occurs with smithsonite at the Silver Rule mine, one-quarter mile south of Inyo county line. Occurs with smithsonite, anglesite, linarite and galena in dolomite at the Ibex mine, six miles north of Saratoga Springs. Platinum has been identified in a lead carbonate ore from the Pinte mine, near Cima.

143. BISMUTOSPHAERITE.

Carbonate of bismuth, Bi_2CO_5.

Concentric globular with radiating fibers. Color bright yellow to brown. H = 3 — 3.5; G = 7.30.

Refractive indices: $\epsilon = 1.94$; $\omega = 2.13$.

Effervesces in acid. Mixed with potassium iodide and sulphur and fused on charcoal, it gives a bright red coating on the outer edge of a yellow coating.

This very rare mineral is formed by the alteration of bismuth minerals, and is always secondary.

San Diego County: Occurs in grayish black masses and as a yellow powder from the alteration of native bismuth at Pala, Schaller[4].

144. PHOSGENITE.

Chlorocarbonate of lead $(PbCl)_2CO_3$.

Tetragonal. Prismatic crystals. Color white to yellow. Adamantine luster. H = 2.5 — 3; G = 6.

Refractive indices: $\epsilon = 2.140$; $\omega = 2.114$.

Effervesces with dilute nitric acid. Easily fusible to yellow bead. Reduced with sodium carbonate to metallic lead. Fused with copper oxide, it gives blue flame of copper chloride.

This is a very rare lead compound, and but one locality in the State is known for its occurrence.

Inyo County: A specimen was found of acicular, straw-yellow crystals in quartz at the Silver Sprout mine, Hanks[6].

145. NORTHUPITE.

Double carbonate of sodium and magnesium with sodium chloride.

$Na_2CO_3.MgCO_3.NaCl$.

Isometric. Octahedral crystals. Colorless to brownish. Vitreous luster. H = 3.5 — 4; G = 2.38.

Refractive index: $n = 1.514$.

Easily fusible, coloring the flame intensely yellow. Soluble in dilute acid, from which magnesia can be precipitated.

Northupite is a new mineral, only known to occur in this State.

San Bernardino County: Some small dirty white and dark brown octahedrons of the combined carbonates and chloride were discovered in 1895 at Searles Borax Lake and named by Foote[1]. An analysis was made by Pratt[1].

CO_2	Cl	SO_3	MgO	Na_2O	H_2O	Insol.	O for Cl
35.12	14.10	0.08	16.08	36.99	0.72	0.22	$=100.31-3.16=100.15$ per cent

146. TYCHITE.

Double carbonate of sodium and magnesium with sodium sulphate,

$2MgCO_3.2Na_2CO_3.Na_2SO_4$.

Isometric. Small octahedral crystals. Color white. Vitreous luster. H = 3.5 — 4; G = 2.58.

Refractive index: $n = 1.508$.

Similar to northupite in its reactions.

This new mineral was found with northupite, and likewise is only known from the one locality.

San Bernardino County: A few small octahedrons of the combined carbonates and sulphate were mixed with the northupite crystals and discovered in 1905 and named by Penfield and Jamieson[1].

SO_3	CO_2	MgO	Na_2O	
15.08	33.55	15.83	35.49	$=99.95$ per cent
15.06	33.45	15.77	35.65	$=99.93$

HYDROUS CARBONATES.

147. MALACHITE—Green Copper

Basic carbonate of copper, $CuCO_3.Cu(OH)_2$.

Monoclinic. Fibrous, radiating tufts, botryoidal, stalactitic. Color green. Streak green. Vitreous luster. H = 3.5 — 4; G = 4.

Refractive indices: $\alpha = 1.655$; $\beta = 1.875$; $\gamma = 1.909$.

Effervesces in nitric acid. Ammonia turns solution deep blue.

Malachite is to be found practically in every locality where there is the least trace of copper, as it is the common alteration mineral of copper compounds. As an indication of the presence of copper, it occurs in green coatings and stains, and in the oxidized portion of copper veins it often forms beautiful drusy and velvety crystallizations. Azurite is often associated.

Amador County: Fine reniform masses have come from Volcano.

Calaveras County: Frequently seen at Campo Seco and Copperopolis, but more as stains than as good specimens. Fine specimens came from the old Hughes mine, W. P. Blake[9].

Del Norte County: Occurs with magnetite and chalcocite at French Hill; with chalcopyrite and bornite at the Diamond mine, Low Divide; at the Morning Star mine, Rockland district, associated with magnetite.

Humboldt County: Excellent specimens have come from Horse Mountain, also from the Mattole district.

Inyo County: Good drusy malachite occurred in the Cerro Gordo district. Found associated with chrysocolla ten miles east of Death Valley Junction.

Kern County: Found in the San Emidio Canyon associated with azurite.

Kings County: Observed at Anshall Creek.

Lake County: Occurs on the Langtry Ranch, seven miles south of Middletown.

Lassen County: Associated with azurite at Copper King mine, near Westwood.

Los Angeles County: Occurs with azurite on Upper San Gabriel River.

Mariposa County: Fine drusy coatings and excellent specimens of crystallized malachite occur at the White Rock mine. Good specimens with azurite at the Peterson and Cornet mines.

Mendocino County: With native copper in serpentine at Red Mountain, ten miles southeast of Ukiah. In the Anderson Valley as alteration of chalcopyrite.

Mono County: Common alteration mineral in the Blind Springs district. Good specimens of malachite with cuprite and melaconite occur at the Detroit mine.

Monterey County: Some malachite has been observed in the serpentine east of Parkfield.

Napa County: Occurred with some covellite and chalcocite in the Jumper group of mines.

Placer County: Large amounts with native copper at the Algol mine, nine miles northeast of Lincoln.

Plumas County: Good specimens associated with bornite and chalcocite occur in Light's Canyon. Large masses in limestone at the Bluebell mine, Genessee district. With azurite as a vein in the Pettinger mine, near Taylorville. Excellent specimens with chalcocite at Green Ledge, Genessee Valley. As an alteration of chalcocite and bornite at the Oregon, Olympia, Polar Star and Engel mines. Occurs in a barite gangue with hematite and yellow limonite, in Cook's Canyon.

Riverside County: Observed in the Monte Negro district as an alteration of chalcopyrite. Occurs with azurite and cuprite in Ironwood, Palen and Santa Maria Mountains. Green copper carbonate occurs as an alteration of copper sulphides at Crestmore.

San Benito County: Associated with azurite at the Towle Copper mine near Elkhorn.

San Bernardino County: One of the minerals found in the Calico district; also quite common in the oxidized copper ores of the eastern part of the county. Occurs with chalcocite and bornite four miles east of Judson.

San Diego County: Excellent specimens have come from three miles south of Julian.

San Luis Obispo County: Occurs on Santa Lucia Mountains and on Chorro Creek.

Trinity County: Observed on Dobbyn Creek. Sparingly at the Copper Queen Lode, Carrville. Occurs as a secondary mineral at Island Mountain.

Tuolumne County: Occurs with chalcopyrite at the Greenstone mine.

148. AZURITE—Blue Malachite.

Basic carbonate of copper, $2CuCO_3.Cu(OH)_2$.

Monoclinic. Good crystals, massive, earthy. Color deep azure-blue. Streak light blue. Vitreous to adamantine luster. H=3.5—4; G=3.77—3.83.

Refractive indices: $\alpha=1.730$; $\beta=1.754$; $\gamma=1.836$.

Similar to malachite in reactions, but easily distinguished by color.

The blue azurite is not so common as the green malachite with which it is usually found. It occurs generally in aggregates of distinct crystals, often lining cavities in limonitic and malachitic masses. Most copper districts may have some azurite formed as an oxidation mineral.

Butte County: Observed with malachite near Bangor.

Calaveras County: Fine crystals occurred with malachite at the old Hughes mine, W. P. Blake[9]. Some azurite with malachite has been found in the Santa Cruz mine near Robinson's Ferry. Also at the Telegraph mine, Hog Hill.

El Dorado County: Good specimens of the two carbonates have been found at the Alabaster Cave mine, Cave City.

Inyo County: Occurs with melaconite, malachite, and chrysocolla in the Greenwater district, Black Mountains; at the Mountain View mine, Panamint; at the Half Dollar mine it occurred with pink and white lepidolite.

Kern County: In the Cinco district it is associated with malachite, galena, anglesite and cerussite. Fine specimens have been found in San Emidio Canyon.

Lassen County: With malachite near Westwood.

Madera County: Occurs with malachite in the old Buchanan mine.

Mariposa County: Fine crystals occur in the Hawlington district. Observed in the White Rock mine.

Modoc County: Occurs seven miles south of Fort Bidwell with malachite, cuprite and native copper.

Mono County: Crystals on limonite from the Diana mine had the forms: (001), ($\bar{1}$02), (012), (011), (110), (111), Jackson[3].

Napa County: Some azurite and malachite have been found near Monticello.

Placer County: Small amounts observed in copper mines seven miles north of Auburn.

Plumas County: Occurs with malachite near Taylorsville at the Pettinger and Polar Star mines.

Riverside County: Occurs in the Ironwood and Palen Mountains with malachite and cuprite. Blue azurite is associated with malachite at Crestmore.

San Benito County: Small crystals occur at the Towle Copper mine near Elkhorn.

San Bernardino County: Occurs with malachite and copper sulphides in the Signal mining district. Specimens have come from the Bumper claims near Needles.

Siskiyou County: With malachite near Gazelle and in the Bonanza mine near Honolulu.

Sonoma County: Small perfect crystals with malachite occur eight miles northeast of Cazadero.

Trinity County: Occurs with malachite as a secondary mineral at Island Mountain.

Tuolumne County: Observed at Whiskey Hill, and in various mines of the county in small amounts.

149. AURICHALCITE.

Basic carbonate of zinc and copper, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.

Monoclinic. Plumose, tabular, laminated. Color pale green, bluish green. Streak like color. Pearly luster. H = 2; G = 3.54 — 3.64.

Refractive indices: $\alpha = 1.654$; $\beta = 1.740$; $\gamma = 1.743$.

Easily soluble with effervescence. In a closed tube, blackens and gives water. On charcoal, when mixed with sodium carbonate, it gives yellow coating of zinc and globules of copper.

This is a very rare secondary mineral, and has only been found in two localities in the State.

Inyo County: Plumose aggregates and long prismatic crystals associated with calamine and chrysocolla occurred in specimens from the Cerro Gordo mine. Has been mentioned from this locality by Rogers[5].

Mono County: Occurs as pale green fissure fillings in magnetite containing sphalerite, from near Topaz.

150. HYDROZINCITE.

Basic carbonate of zinc, $ZnCO_3$. $Zn(OH)_2$.

Massive and earthy. Generally as incrustations. Snow-white color. Dull luster. H=2—2.5; G=3.58—3.8.

Refractive indices: α =1.640; β=1.736; γ=1.750.

Soluble with effervescence in dilute acid. Gives water in closed tube. Intensely heated on charcoal with cobalt nitrate, will assume green color of zinc and give globules of copper.

Hydrozincite is formed as a secondary mineral from the alteration of sphalerite. It is rare in the State.

Inyo County: Thick layers of the white carbonate occur at the Cerro Gordo mine with sphalerite, willemite and calamine; has been mentioned from this locality by Rogers[5].

151. DAWSONITE.

Basic carbonate of aluminium and sodium, $Na_3Al(CO_3)_3.2Al(OH)_3$.

Monoclinic. Incrustations. Color white. Vitreous luster. H=3; G=2.4.

Refractive indices: α =1.466; β=1.542; γ=1.596.

Effervesces easily. Swells and fuses, coloring flame deep yellow and fused mass gives an alkaline reaction. With cobalt nitrate gives a fine blue color. Gives water in closed tube.

Dawsonite is a very rare mineral, and occurs in arid regions as white crusts.

Inyo County: Reported to occur as a soft incrustation in a dike in Amargosa Canyon, Bailey[1].

152. THERMONATRITE.

Hydrous carbonate of sodium, $Na_2CO_3.H_2O$.

Orthorhombic. Usually as efflorescences. Color white, yellowish. Vitreous luster. H=1—1.5; G=1.5—1.6. Taste alkaline.

Refractive indices: α =1.420; β=1.506; γ=1.524.

Soluble in water and has alkaline taste. Strong yellow flame of sodium and gives an alkaline reaction, on heating.

This is a very rare mineral which forms as efflorescences in arid regions.

Inyo County: Forms white efflorescent coatings in Death Valley, according to Bailey[1].

153. GAY LUSSITE.

Hydrous carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.5H_2O$.

Monoclinic. Flat wedge-shaped crystals. Cleavage perfect prismatic. Color white. Vitreous luster. H=2—3; G=1.93—1.95.

Refractive indices: $\alpha=1.444$; $\beta=1.516$; $\gamma=1.523$.

Easily fusible to a white enamel with strong yellow flame. Gives alkaline reaction on turmeric paper. Easily effervesces. Gives water in closed tube. Calcium shown by precipitation with ammonium oxalate.

This double carbonate is frequently formed on the shores of soda lakes in flat wedge-shaped crystals. Found only in dry regions.

Mono County: Found in crystals on the shore of Mono Lake.

San Bernardino County: One of the minerals of the Searles Borax Lake, Hanks[10]. The forms on the crystals from this lake as determined by Pratt [1] are: (010), (001), (110), (011), ($\bar{1}$01), ($\bar{1}$12). Bailey[1] mentions it as occurring at the Owl Springs niter beds.

154. NATRON.

Hydrous carbonate of sodium, $Na_2CO_3.10H_2O$.

Monoclinic. Exists only in solution or mixed with trona. Tabular crystals obtained by the evaporation of waters from soda lakes. Color white. Vitreous luster. H=1—1.5; G=1.42—1.46. Taste alkaline.

Refractive indices: $\alpha=1.405$; $\beta=1.425$; $\gamma=1.440$.

Soluble in water and effervesces in acids. Gives intensely yellow flame and reacts alkaline.

The normal carbonate of soda has not been found in native state, but it exists in solution in some of the lakes and springs of the State. Crystals of the carbonate, mixed with the bicarbonate, are obtained by evaporating the water of Owens Lake and other soda lakes of Death Valley and San Bernardino County. The solid contents of Owens Lake have been analysed by Foster[1] and Chatard[1].

155. TRONA—Urao—Soda.

Hydrous bicarbonate of sodium, $Na_2CO_3.HNaCO_3.2H_2O$.

Monoclinic. Slender crystals and fibrous masses. Cleavage perfect orthopinacoidal. Color white. Vitreous luster. H=2.5—3; G=2.11—2.14. Taste alkaline.

Refractive indices: $\alpha=1.412$; $\beta=1.492$; $\gamma=1.540$.

Like natron in reactions. Much water in a closed tube.

The bicarbonate is the common form of soda found in lakes and springs. In dry protected localities it exists as crystals and finely fibrous coatings.

Mono County: The solid contents of the waters of Owens Lake are mainly trona, and the mineral occurs along the shores in white layers.

Chatard[1] analyses of the solid matter of this lake show it to be over 90 per cent pure soda.

San Bernardino County: Soda is quite common in this county at the various sinks and borate lakes. At Searles Borax Lake it is the material mined, and large amounts of it have been accumulated. Thick layers of solid trona occur with the borax, hanksite, thenardite, glauberite and other salts. Crystals are very common. They are elongated right and left, and have the forms: (100), (001), (101), ($\bar{3}02$), (111), ($\bar{1}11$), (211), Ayers[2].

156. PIRSSONITE.

Hydrous double carbonate of calcium and sodium, $CaCO_3.Na_2CO_3.2H_2O$.

Orthorhombic. Hemimorphic crystals. Colorless to white. Vitreous luster. H=3 — 3.5; G=2.352.

Refractive indices: $\alpha=1.504$; $\beta=1.510$; $\gamma=1.575$.

Similar to gay lussite in its reactions. Boiled in water the sodium carbonate is leached out and causes the solution to become strongly alkaline.

Pirssonite is a mineral discovered in California in 1896 and only known from the one locality.

San Bernardino County: Good hemimorphic crystals of this salt were found with northupite and borax at the New Well, Searles Borax Lake, and the mineral was described and named by Pratt[1]. Forms: (010), (110), (111), (11$\bar{1}$), (131), (311).

CO_2	CaO	Na_2O	K_2O	H_2O	Al_2O_3	SiO_2	
36.07	23.38	25.70	0.15	14.73	0.13	0.29	=100.45 per cent

157. HYDROMAGNESITE—Hydrodolomite.

Hydrous carbonate and hydrate of magnesium, $3MgCO_3.Mg(OH)_2.3H_2O$.

Monoclinic. Generally massive chalky. Color white. Vitreous, silky to dull luster. H=3.5, crystallized; G=2.14 — 2.18.

Refractive indices: $\alpha=1.527$; $\beta=1.530$; $\gamma=1.540$.

Easily effervesces in dilute acids and the solution made alkaline with ammonia and sodium phosphate added, the magnesia is precipitated.

Soft white veins of a hydrated magnesite have been found in the serpentine, but most of these veins are classed as magnesite.

Alameda County: A specimen of hydromagnesite from Livermore was analysed by Gutzkow[1].

$SiO_2Al_2O_3Fe_2O_3$	CaO	MgO	CO_2	H_2O	Moisture
1.25	tr.	43.00	36.30	18.70	0.75

Massive white hydromagnesite has been found near Pleasanton.

Inyo County: Said to occur in chalky and mealy crusts in spots along the Amargosa River, Bailey[1].

Riverside County: Crystals of hydromagnesite occur in the calcite at Crestmore as an alteration product of brucite.

San Benito County: Hydromagnesite occurs with magnesite in powdery white balls, on Larious Creek, on slope of Sampson Peak, and was analysed by W. B. Hicks. Deposit described by Gale[7].

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	CO_2	H_2O?
2.50	0.13	0.44	0.34	41.60	34.89	19.21=99.11%

San Francisco County: Small white veins are found in the serpentine of San Francisco. Radiating rosettes of hydromagnesite occur on the serpentine at Fort Point. The white veins in the serpentine of San Francisco are in part hydrolomite and in part hydromagnesite.

San Luis Obispo County: Small veins found in the rocks near Port Harford.

158. HYDROGIOBERTITE.

Hydrous magnesium carbonate, $2MgO.CO_2.3H_2O$.

Spherulitic incrustations. Light gray color. H=3—4; G=2.152. Effervesces with hydrochloric acid.

Napa County: Found in Chiles Valley near Philips Springs and analysed by Wells[1].

MgO	CO_2	H_2O
46.94	23.64	21.42
45.80	28.00	26.20

Larsen has shown by a microscopic and optical examination that it is a mixture of two fibrous minerals and is probably hydromagnesite.

159. ZARATITE.

Hydrous carbonate of nickel, $NiCO_3.2Ni(OH)_2.4H_2O$.

Incrustations. Massive. Color emerald-green. Streak green. Vitreous luster. H=3; G=2.57—2.69.

Refractive index: n=1.57—1.61.

Effervesces in hot acid. Gives water in closed tube. Imparts to the borax bead a brown color which, when reduced, becomes gray and cloudy.

The emerald-green nickel carbonate is always accompanied by chromite, occurring as an incrustation on massive chromite. Most of the green coatings on the chromite of the State consist of small uvarovite garnet crystals or green chlorite.

Alameda County: Green coatings of zaratite occur on the chromite at Mendenhall mine on Cedar Mountain.

Madera County: Found as coating on chromite near Madera.

Monterey County: Found on chromite in this county, W. P. Blake[9].

San Benito County: Found on chromite near Hollister and near Panoche.

Shasta County: Observed on the chromite at Castella.

Siskiyou County: Green coatings occur on the chromite near Callahan.

160. BISMUTITE.

Hydrous carbonate of bismuth, $Bi_2CO_5.H_2O$.

Incrustations and earthy. Color white and dirty green. Streak greenish gray. Vitreous to dull luster. H=4 — 4.5; G=6.9.

Refractive indices: ϵ=2.20; ω=2.6.

Effervesces in acid. Fused on charcoal with potassium iodide and sulphur, it gives a red coating. A small amount of water is obtained by heating in a closed tube.

The carbonate of bismuth is a secondary mineral formed by the alteration of ores containing bismuth.

Fresno County: Occurred at the Second Sierra and Lot One mines, Kings River.

Inyo County: Found at Big Pine Creek, Hanks[6]; also at Antelope Springs, Deep Spring Valley. Fibrous and crypto-crystalline specimens have been found near Lone Pine.

Los Angeles County: White earthy bismutite has been found in this county.

Mono County: Found at Oasis, Hanks[6].

San Bernardino County: Occurs as an alteration of associated bismuthinite at the United Tungsten Copper mine, Morongo district.

San Diego County: Occurs as an alteration of bismuth at Pala, Schaller[4].

CHAPTER VIII.

ANHYDROUS SILICATES.

Feldspars.
- Orthoclase
- Microcline
- Anorthoclase
- Albite
- Oligoclase
- Andesine
- Labradorite
- Bytownite
- Anorthite

Pyroxene Group.
- Enstatite
  - Bronzite
- Hypersthene
- Pyroxene
  - Malacolite
  - Diopside
  - Diallage
  - Omphacite
  - Augite
  - Violan
  - Hedenbergite
- Acmite
  - Aegirite
- Spodumene
  - Kunzite
  - Hiddenite
- Wollastonite
- Pectolite
- Rhodonite

Amphibole Group.
- Anthophyllite
- Amphibole
  - Tremolite
    - Asbestos
  - Actinolite
  - Smaragdite
  - Cummingtonite
  - Uralite
  - Asbeferrite
  - Edenite
  - Hornblende
  - Soretite
  - Pargasite
  - Caranthine
- Glaucophane
- Crocidolite

Not Grouped.
- Beryl
- Nepheline
- Sodalite
- Nosean
- Lazurite
- Garnet
- Monticellite
- Olivine
- Tephroite
- Iddingsite
- Willemite
- Wernerite
  - Scapolite
- Gehlenite
- Merwinite
- Vesuvianite
  - Californite
- Zircon
- Topaz
- Andalusite
- Sillimanite
- Cyanite
- Spurrite
- Datolite
- Zoisite
  - Saussurite
  - Clinozoisite
- Epidote
- Allanite
- Piedmontite
- Axinite
- Prehnite
- Chondrodite
  - Lotrite
- Ilvaite
- Calamine
- Lawsonite
- Tourmaline
- Dumortierite

FELDSPARS.

The name feldspar is given to a group of alumina silicates with potash, soda and lime, whose members have the general properties of hardness, cleavage, gravity and twinning similar. They include: two potash feldspars, *orthoclase* and *microcline;* a potash-soda feldspar, *anorthoclase;* a soda feldspar, *albite;* a lime feldspar, *anorthite;* and four soda-lime to lime-soda feldspars intermediate between albite and anorthite, namely *oligoclase, andesine, labradorite* and *bytownite.* The feldspars are the most abundant and most important of the rock-forming silicates, and the classification of a volcanic rock is in general based upon the prevailing feldspar. The potash feldspars are characteristic of the acid volcanics, while the albite-anorthite feldspars belong to the basic volcanics, the terms "acid and basic" meaning whether high or low in silica percentage. The albite-anorthite feldspars are commonly

called the "plagioclase feldspars," and in many petrographic descriptions this name is used, so that the particular kind of feldspar is not designated. As rock-forming minerals the feldspars are too universally distributed to give many localities.

161. ORTHOCLASE—Potash Feldspar.

Silicate of potassium and aluminium. $KAlSi_3O_8$.

Monoclinic. Crystals very common. Often as Carlsbad twins. Perfect basal and clinopinacoidal cleavage. Colorless, white, flesh-red. Vitreous luster. H = 6 — 6.5; G = 2.57.

Refractive indices: $\alpha = 1.518$; $\beta = 1.524$; $\gamma = 1.526$.

Fused at 5 in the scale of fusibility, therefore can only be rounded on edges of splinter. Insoluble in acids. The powder mixed with gypsum, taken on the loop of a platinum wire and held in the colorless flame of a Bunsen burner, will give the violet flame of potassium, best seen through blue glass or the Merwin color screen.

Orthoclase is an essential constituent of the acid igneous rocks, granites, syenites, quartz-porphyries, rhyolites and trachytes, and an occasional constituent of other more basic rocks. Large crystals often form the phenocrysts of porphyritic rocks, and these crystals are often "Carlsbad twins." The color of granites is mainly due to the color of the orthoclase, red granites having orthoclase colored by ferric oxide. Granites, syenites and diorites are often intersected by "pegmatite veins" consisting of coarse crystals and massive orthoclase, with quartz and mica, and these veins vary greatly in width, and some can be quarried for the feldspar. The principal commercial localities in California are in Monterey, Riverside, San Diego, and Tulare counties.

Adularia is a glassy, transparent variety, sometimes found in large crystals.

Sanidine is a glassy potash feldspar, common to rhyolites and trachytes.

Valencianite is a variety name given to vein orthoclase.

162. MICROCLINE—Potash Feldspar.

Silicate of potassium and aluminium, $KAlSi_3O_8$.

Triclinic. Crystals very common. Bases often show rectangular grating structure. Cleavage like orthoclase. Color white, green. H = 6 — 6.5; G = 2.54 — 2.57.

Refractive indices: $\alpha = 1.522$; $\beta = 1.526$; $\gamma = 1.530$.

Same reactions as for orthoclase.

Microcline has the same composition as orthoclase, but differs from it in its twinning structure and crystallization. It is a constituent of granites, syenites, and granodiorites and some of the pegmatitic veins.

Amazon stone is a green variety.

163. ANORTHOCLASE—Potash-Soda Feldspar.

Silicate of potassium, sodium and aluminium, $KAlSi_3O_8$ with $NaAlSi_3O_8$ in varying proportions.

Triclinic. Crystals observed in rock sections. Like orthoclase in its physical properties. H = 6 — 6.5; G = 2.57 — 2.60.

Refractive indices: $\alpha = 1.523$; $\beta = 1.529$; $\gamma = 1.531$.

Same reactions as for orthoclase.

Anorthoclase is a constituent of granites and granodiorites of the State, but has seldom been mentioned in the petrographical descriptions.

164. ALBITE—Soda Feldspar.

Silicate of sodium and aluminium, $NaAlSi_3O_8$.

Triclinic. Crystals common and usually as repeated twins. Often massive. Cleavage perfect basal and brachypinacoidal. Colorless and white. Vitreous luster often very glassy. H = 6 — 6.5; G = 2.62 — 2.65.

Refractive indices: $\alpha = 1.525$; $\beta = 1.529$; $\gamma = 1.536$.

Fused at 4 and imparts a bright yellow color to flame. Unacted on by acid.

The soda feldspar is a common constituent of acid granites, acid rhyolites, granodiorites and diorites and metamorphic gneisses and schists. It forms very prominent white veins in the crystalline schists of the Coast Ranges and the Sierras. Albite is frequent as pegmatitic veins in diorites and basic igneous rocks.

165. OLIGOCLASE—Soda-lime Feldspar.

Silicate of sodium, calcium and aluminium, $m NaAlSi_3O_8$ with $n CaAl_2Si_2O_8$, nearer albite in composition.

Triclinic. Crystals, usually twinned like albite. Cleavage perfect basal and brachypinacoidal. Colorless to white. H = 6 — 6.5; G = 2.65 — 2.67.

Refractive indices: $\alpha = 1.539$; $\beta = 1.543$; $\gamma = 1.547$.

Same reactions as albite. The calcium can be determined in the wet way, by precipitation as calcium oxalate. All insoluble silicates need to be fused with sodium carbonate to render them soluble.

A constituent of diorites, porphyrites, andesites, etc., and to some extent in granites, syenites and granodiorites. Occasionally found in large white masses as veins in diorite and other basic rocks.

Moonstone is a soda-lime feldspar with milky chatoyancy. Much of the so-called moonstone is chalcedony.

166. ANDESINE—Soda-lime Feldspar.

Silicate of sodium, calcium and aluminium, intermediate between albite and anorthite.

Triclinic. Crystals similar to albite. H=5—6; G=2.68—2.60.

Refractive indices: α=1.550; β=1.553; γ=1.557.

Same reactions as for oligoclase.

A constituent of diorite, gabbro, porphyrite, andesite and other basic rocks. Only observed as a microscopical constituent.

167. LABRADORITE—Lime-soda Feldspar.

Silicate of calcium, sodium and aluminium, $CaAl_2Si_2O_8$ with $NaAlSi_3O_8$, nearer anorthite in composition.

Triclinic. Small twinned crystals in rocks; sometimes massive with twinning striations. Properties like oligoclase. H=5—6; G=2.70—2.72.

Refractive indices: α=1.559; β=1.563; γ=1.568.

Same reactions as for oligoclase. The mineral is slightly acted on by hydrochloric acid.

An essential constituent of most basic eruptive rocks such as diorites, gabbros, diabases, andesites and basalts. Sometimes it occurs as veins of large cleavable masses.

168. BYTOWNITE—Lime-soda Feldspar.

Silicate of calcium, sodium and aluminium, near anorthite in composition.

Triclinic. Properties like oligoclase. H=5—6; G=2.72.

Refractive indices: α=1.566; β=1.572; γ=1.576.

Somewhat more soluble than labradorite. Gives the red flame of calcium.

A common constituent of very basic rocks like gabbros, diabases and basalts, associated with labradorite and anorthite.

169. ANORTHITE—Lime Feldspar.

Silicate of calcium and aluminium, $CaAl_2Si_2O_8$.

Triclinic. Generally in small crystals as a rock constituent. Properties like oligoclase and labradorite. H=6—6.5; G=2.74—2.76.

Refractive indices: α=1.576; β=1.584; γ=1.588.

Soluble slowly and yields gelatinous silica. Gives the red flame of calcium. Fused at 4.

Anorthite is the most basic of the feldspars, and is a constituent of the very basic rocks, especially gabbros, diabases and basalts.

A few of the localities where feldspars have been noticed may be cited.

Alameda County: Good crystals of glassy albite occur at the Newman mine, Cedar Mountain, associated with yellow euhedral quartz.

Calaveras County: Large crystals of orthoclase occur at Mokelumne Hill. Albite is a common constituent of the schists of the Mother Lode.

Crystals of albite from the old Stanislaus mine, Carson Hill, had the forms: (010), (001), ($\bar{1}11$), ($\bar{1}01$) ($1\bar{1}0$), ($\bar{1}30$), (021), Jackson[3]. Crystals from Angels had the forms: (010), (110), ($1\bar{1}0$), (111), ($\bar{1}\bar{1}1$), (001), Genth[2].

The mineral from Angels was analysed by Genth.

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	
68.39	19.65	0.41	0.47	10.97	tr.	0.21	100.10 per cent

Valencianite occurs five miles east of Milton in small prismatic crystals. Forms: (160), ($10\bar{1}$), (001) and (010), Rogers[5].

Contra Costa County: Albite is a common constituent of the chlorite and actinolite-schists of the county. Numerous white veins of the mineral intersect these schists. Prominent as veins in the actinolite schist near San Pablo and analysed by Blasdale[1].

				H_2O		
SiO_2	Al_2O_3	CaO	Na_2O	at 100°	ab 100°	
67.09	20.47	0.24	10.96	0.27	0.59	99.62 per cent

El Dorado County: Large white crystals of orthoclase occurred at the old Cosumnes copper mine near Fairplay with bornite, molybdenite, epidote and axinite. Massive red orthoclase occurs with tourmaline at Buck's Bar, Cosumnes River. Small colorless crystals of adularia have been found on the south side of Fallen Leaf Lake with forms (110), ($\bar{1}01$), (001), and (010). They are associated with pale green diopside, Rogers[5]. Albite with siderite and calcite occurs at the Red Hill mine, Kelsey district.

Fresno County: Bodies of feldspathic rock, mainly orthoclase, as pegmatites, occur five miles northeast of Trimmer, and beryl and topaz are said to be associated.

Humboldt County: Glassy crystals of albite are common as veins in the schist of Horse Mountain.

Inyo County: White argentiferous orthoclase occurred at the White Lime mine, Deep Spring district. Glassy adularia was found in good crystals at Rialto in the Funeral Mountains. Pink perthite occurs six miles east of Tecopa.

Kern County: White orthoclase was reported from the Long Tom mine. Albite in schists occurs near Randsburg and Johannesburg. A massive flesh-red orthoclase occurs near Rosamond.

Los Angeles County: White veins of labradorite occur near Lang. Labradorite is a constituent of the rocks on Mount Gleason.

Madera County: Massive white orthoclase is found near Hildreth.

Marin County: Albite veins are common in the schists of the county. Crystals from the lawsonite schist at Reed Station have the forms: (001), (010), (021), ($0\bar{2}1$), ($\bar{1}01$), ($\bar{2}01$), (150), (130), ($\bar{1}11$), ($\bar{1}\bar{1}1$), ($\bar{1}12$), ($\bar{1}31$), ($\bar{2}21$), (120), (350), (110), ($1\bar{1}0$), ($1\bar{3}0$), ($\bar{1}\bar{1}2$), ($\bar{2}\bar{2}1$), ($\bar{2}\bar{4}1$), ($\bar{3}12$), Schaller[10].

Mariposa County: Orthoclase occurs with black tourmaline and molybdenite in the granites of the Yosemite Valley. Labradorite occurs in the rocks of Yosemite Park.

Modoc County. Pink orthoclase occurs in a pegmatite near Susanville. Pebbles of labradorite from this county were found containing small opaque inclusions of native copper, making them aventurine labradorite.

Mono County: Orthoclase is found in pegmatitic veins in the Blind Spring district.

Monterey County: Large phenocrysts of orthoclase occur in the porphyritic rock at Pacific Grove and Cypress Point. The potash feldspar is quarried four miles east of Chualar for pottery. Massive cream-colored orthoclase from Jem Quarry, four miles east of Chualar, occurs on contact between limestone and granite, and was analysed by E. W. Rice:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Loss
65.66	21.34	0.40	1.50	tr.	11.85	0.48 = 101.23%

Nevada County: Anorthoclase and microcline are constituents of the diorite and granodiorite, and labrodorite, bytownite and anorthite of the diorite and gabbro of Nevada City and Grass Valley, Lindgren[6]. Good crystals of albite occur at Grass Valley.

Plumas County: Albite is a constituent of the syenite of Spanish Creek, Murgoci[1]. Oligoclase was described by Lawson[3] as a constituent of plumasite from Spanish Peak and the mineral was analysed by J. Newfield.

SiO_2	Al_2O_3	CaO	Na_2O	H_2O	
61.36	22.97	5.38	8.08	1.72	= 99.51 per cent

Labradorite, andesite, oligoclase and albite occur as constituents of the noritic rocks at Engels.

Riverside County: An outcrop of orthoclase and quartz occurs in the granite hills, four miles south of Lakeview. Also on Warren Ranch three miles east of Lakeview. Massive quartz and feldspar occur 3½ miles northeast of Murrietta. Orthoclase feldspar occurs near Nuevo.

San Benito County: Albite occurs in grayish and greenish, minute twinned crystals in the rock surrounding the veins of benitoite and neptunite near the headwaters of the San Benito River. Forms: (001), (010), (110), (1$\bar{1}$0), (1$\bar{2}$0), (130), (1$\bar{3}$0), ($\bar{1}$01), (1$\bar{1}$1), ($\bar{1}\bar{1}$1), ($\bar{1}\bar{1}$2), ($\bar{1}\bar{3}$1), ($\bar{2}\bar{2}$1), Louderback[2].

San Bernardino County: Veins of orthoclase occur in the mountains in the northeastern part of the county. Massive red orthoclase occurs near Manvel. Giant crystals of orthoclase are abundant in granite-porphyry dikes 1½ miles southwest of Twenty-nine Palms, some of them

Carlsbad Twins. Orthoclase as a constituent of pegmatite dikes intersecting granite occurs 1½ miles south of Oro Grande. Some occurs 3½ miles north of Hinkley Station. Orthoclase and albite occur as pegmatite veins containing columbite, cassiterite and blue tourmaline, in the Chihuahua Valley.

San Diego County: Albite was mentioned as a constituent of some of the rocks of the county by Kroustchoff[1] and analysed by him.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Ign	
65.17	tr.	21.14	0.74	1.20	0.04	1.70	9.20	0.80	=99.89 per cent

Large veins of acid pegmatite consisting of albite, orthoclase and microcline intersect dark gray diorite at Pala, Mesa Grande, Rincon and Ramona, as well as northward into Riverside County, and these veins carry large crystals of gem tourmaline and associated minerals. Large crystals of the feldspars occur in these veins showing Carlsbad, Baveno and albite twinning structure. Crystals of albite at the Victor mine, Rincon, occur tabular to (010) with forms (010), (001), (110), $(1\bar{1}0)$, $(1\bar{3}0)$, $(\bar{1}01)$, $(\bar{2}01)$, $(\bar{1}11)$, $(\bar{1}\bar{1}1)$, Rogers[2].

Anorthite is a constituent of the orbicular gabbro at Dehesa and was analysed by Schaller, Lawson[2].

SiO_2	Al_2O_3	CaO	Na_2O	
44.39	36.55	18.55	0.83	=100.32 per cent

A large outcrop of feldspar and quartz occurs near Marina Dam, about five miles north of Campo. Outcrops of orthoclase and quartz occur five miles west of Alpine. Good massive orthoclase near Mesa Grande, Campo and Lakeside.

Santa Barbara County: Labradorite is a constituent of the teschenites at Point Sal and was analysed by Fairbanks[4].

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign	
52.72	30.46	11.01	3.70	0.42	1.44	= 99.75 per cent

Santa Clara County: Oligoclase is a constituent of the glaucophane rocks of this county, Murgoci[1].

Shasta County: Veins of orthoclase occur on Tom Neal Mountain. Good crystals of andesine occur in dikes of andesite porphyry in Jones Valley, fifteen miles northeast of Redding. Good crystals of orthoclase occur in dikes of soda granite-porphyry on Salt Creek along the highway between Baird and Antler.

Tulare County: White crystals of orthoclase occur at Three Rivers. Outcrops occur at Three Rivers and Lemon Cove. Near Exeter it occurs as microcline. Massive perthite occurs near Exeter, Lindsay and at Lemon Cove.

Tuolumne County: Large crystals of orthoclase are found on Sullivan Creek. Graphic granite is common at Soulsbyville.

PYROXENE GROUP.

170. ENSTATITE.

Silicate of magnesium, $MgSiO_3$.

Orthorhombic. Generally massive, lamellar. Cleavage perfect prismatic. Color greenish or brownish gray to brown. Pearly to vitreous luster. H = 5.5; G = 3.1 — 3.3.

Refractive indices: $\alpha = 1.650$; $\beta = 1.653$; $\gamma = 1.656$.

Practically infusible and insoluble. Its constituents can be determined only in the wet way as in the treatment of a silicate.

Enstatite is a rock-forming mineral which is characteristic of gabbroitie roeks and roeks that have been derived from gabbros, like much of the serpentinized roeks of the Coast Range and of the Sierras. It is a rather common mineral but has seldom been mentioned.

Bronzite is a variety in which part of the magnesia is replaced by iron. It occurs in bronze-brown reticulated masses.

Alameda County: Bronzite occurs in some of the rocks of the Berkeley Hills, Hanks[6].

Contra Costa County: Massive enstatite is found in the Diablo Range in this and other eounties to the south.

Del Norte County: Specimens of enstatite have come from this county.

Fresno County: Has been observed in rock near Lindsay.

Kern County: Bronzite was one of the eonstituents of the San Emidio meteorite and was analysed by Whitfield[2].

SiO_2	FeO	MgO	CaO	
54.42	14.03	29.11	9.46	= 100.02 per cent

Mariposa County: Massive bronzite occurs in the gabbroitic rock of the old Mariposa estate.

Nevada County: Enstatite is a constituent of the gabbros of Nevada City, Lindgren[6].

Plumas County: Enstatite and bronzite are constituents of the noritic rock at Engels.

San Franciseo County: Enstatite or bronzite oeeurs abundantly in the serpentine of San Franciseo, Lawson[1], Palache[2], Eakle[1].

San Luis Obispo County: Found in the serpentine at San Simeon.

Sonoma County: Large bladed masses of bronzite associated with glaucophane and garnet have come from this county.

Stanislaus County: Enstatite with actinolite have come from near Patterson.

Trinity County: Observed in the rock near Trinity Center. Bronzite occurs near Hyampom.

Tuolumne County: Light green enstatite occurs in the gabbro between Jamestown and Montezuma and also near Jacksonville.

Yuba County: Green enstatite occurs near Rackerby.

171. HYPERSTHENE.

Silicate of iron and magnesium $(Fe,Mg)SiO_3$.

Orthorhombic. Generally massive, foliated. Cleavage perfect brachypinacoidal. Color brownish green to brown. Pearly to vitreous luster. H = 5 — 6; G = 3.4 — 3.5.

Refractive indices: $\alpha = 1.692$; $\beta = 1.702$; $\gamma = 1.705$.

Infusible and insoluble. Some iron can be dissolved by boiling in hydrochloric acid.

The dark brown hypersthene is a constituent of basic eruptive rocks, especially gabbros and andesites.

Plumas County: A constituent of the hypersthene andesite at La Porte, Turner[1]. Hypersthene is one of the constituents of the norite rock at Engels.

San Diego County: One of the minerals in the orbicular gabbro at Dehesa, Lawson[4].

San Francisco County: A constituent of the dikes cutting the serpentine of San Francisco, Palache[2].

Siskiyou County: Mentioned by J. D. Dana[2] as a constituent of the hypersthene andesite of Mount Shasta.

172. PYROXENE.

Silicate of calcium and magnesium, $CaMg(SiO_3)_2$ with or without mixtures of Fe,Al,Na and K.

Monoclinic. Prismatic crystals, granular. Cleavage perfect prismatic. Color generally some shade of green, often nearly white, brown, black. Vitreous luster. H = 5 — 6; G = 3.2 — 3.6.

The pyroxenes are insoluble in hydrochloric acid. Diopside fuses to a colorless glass. Augite fuses to a shiny black glass.

The pyroxenes are very important rock-forming minerals, the alumina variety augite being an essential constituent of most of the basic eruptives and is occasionally found in syenites and granites. The light colored non-aluminous varieties are more characteristic of metamorphic limestones and schists.

Malacolite. Lime-magnesia pyroxene, $CaMg(SiO_3)_2$. A white pyroxene often found in crystalline limestone near contact with eruptives.

Diopside. Lime-magnesia pyroxene, $CaMg(SiO_3)_2$ with ferrous iron. A light to deep grass-green pyroxene, characteristic of crystalline limestones, metamorphosed eruptives and some schists.

Refractive indices: $\alpha = 1.664$; $\beta = 1.671$; $\gamma = 1.694$.

Diallage. Lamellar or fibrous pyroxene near diopside in composition. Characteristic of gabbros.

Omphacite. A granular non-aluminous pyroxene. Characteristic of eclogites in association with garnet.

Augite. Iron-alumina pyroxene. Dark green to black and commonest of all the pyroxenes. An essential constituent of diorites, gabbros, diabases, basalts, andesites, pyroxenites and other basic eruptives. Mentioned in all petrographic descriptions of basic igneous rocks.

Refractive indices: $\alpha = 1.698$; $\beta = 1.704$; $\gamma = 1.723$.

Violan. A variety name for a violet-colored augite.

Hedenbergite. An iron-rich pyroxene.

Refractive indices: $\alpha = 1.732$; $\beta = 1.737$; $\gamma = 1.751$.

Contra Costa County: Diopside is common in the schists with albite near San Pablo and has been described and analysed by Blasdale[1].

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO
Fresh	51.91	3.55	1.30	2.65	16.15	22.85
Altered	49.62	2.97	2.49	2.99	19.72	19.14

	Na_2O	H_2O at 100°	H_2O ab. 100°	TiO_2	MnO	
Fresh	0.56	0.21	0.86	0.10	0.33	=100.47%
Altered	0.60	--	2.71	--	--	=100.24

El Dorado County: Diallage is a constituent of gabbro on Mount Diablo. Fine dark green crystals of diopside occur near Mud Springs. Occurs in good crystals at the Cosumnes Copper mine.

Inyo County: Masses of malacolite have come from the Panamint Mountains. A constituent of calc-hornfelses at Deep Canyon near Bishop, with diopside, garnet and epidote.

Lake County: Violan occurs in Big Canyon.

Los Angeles County: Large light green crystals of diopside are found near San Pedro.

Nevada County: Diallage is a constituent of the gabbro at Nevada City and Grass Valley, Lindgren[6].

Plumas County: Diallage occurs in gabbro near Grizzly Peak, Turner[1].

Riverside County: Crystals of pale green diopside occur in the limestone at Crestmore, and were described by Eakle[10]. Forms observed were: (001), (010), (100), (110), (011), (021), (111), (221), ($\bar{1}$12), ($\bar{1}$11), ($\bar{2}$21), ($\bar{3}$31), (131), (121), ($\bar{2}$31), ($\bar{2}$11), ($\bar{1}$21), ($\bar{3}$52), ($\bar{7}$53), ($\bar{8}$36), (1$\bar{4}$.3.10) and (10.12.7). A deep green pyroxene resembling omphacite occurs associated with cinnamon-garnet at the Crestmore Quarry. Augite is a constituent of the quartz-monzonite porphyry of the quarry. A white pyroxene occurs in the dolomitic limestone of Eagle Mountains.

San Francisco County: Crystals of diallage occur in the serpentine of San Francisco, Erman[1], Lawson[2], Palache[2].

San Mateo County: Diallage occurs in gabbro near Crystal Springs.

Santa Barbara County: Augite as a constituent of teschenite at Point Sal was analysed by Fairbanks[4].

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2OK_2O	Ign		
46.59	9.69	1.03	4.75	21.38	13.89	1.23	1.22	=99.78%	G=2.338

Santa Clara County: Diallage occurs at Los Gatos Creek. Omphacite is a constituent of eclogite in the Calaveras Valley, Murgoci[1].

Shasta County: Hedenbergite occurs associated with ilvaite at Potter's Creek, Prescott[1].

Tulare County: Specimens of white malacolite have come from this county.

Tuolumne County: Diallage occurs in the gabbro of Rawhide Ranch.

173. ACMITE—AEGYRITE.

Silicate of sodium and iron, essentially $NaFe(SiO_3)_2$.

Monoclinic. Prismatic crystals. Color brown or dark green. Vitreous luster. H=6 — 6.5; G=3.50 — 3.55.

Acmite: Refractive indices: $\alpha=1.765$; $\beta=1.805$; $\gamma=1.820$.

Aegyrite: Refractive indices: $\alpha=1.708$; $\beta=1.734$; $\gamma=1.758$.

Insoluble, but fuses quietly to a globule which is slightly magnetic and gives a yellow sodium flame.

Acmite and aegyrite are rock-forming minerals more prominent in syenites. Their occurrence in California has not been mentioned in petrographical literature.

San Benito County: A specimen of rock containing prisms of acmite has come from some locality near Hollister. Aegyrite occurs in stellate groups in the albite associated with benitoite and natrolite, at the benitoite locality near the headwaters of the San Benito River, Louderback[2].

174. SPODUMENE.

Silicate of lithium and aluminium, $LiAl(SiO_3)_2$.

Monoclinic. Crystals sometimes very large. Cleavage perfect prismatic. Color grayish white, emerald-green, lilac, amethystine. Vitreous luster. H=6.5 — 7; G=3.13 — 3.20.

Refractive indices: $\alpha=1.660$; $\beta=1.666$; $\gamma=1.676$.

Fuses to a clear glass and gives a red lithium flame, best seen through blue glass or through a Merwin color screen. Insoluble.

Spodumene is found in large crystals and cleavage masses in pegmatitic veins where lithia is present. It is commonly associated with the lithia mica, lepidolite, and with lithia tourmaline.

Kunzite is a beautiful transparent variety, lilac or amethystine in color. Sometimes called *California iris*.

Hiddenite is an emerald green spodumene.

Riverside County: Some kunzite occurs in the San Jacinto Mountains, near Coahuila, Schaller[2].

San Diego County: The transparent lilac variety discovered in 1903 and named kunzite by Baskerville[1], and which is used as a gem, occurs in the pegmatite veins of the Pala Chief mine at Pala with the gem tourmaline, although not very abundant nor in large pieces. Most of it is in flat cleavage pieces but fair crystals have been found with the forms: (010), (100), (110), (130), (350), (320), (121), ($\bar{1}$12), Schaller[2]. The mineral has been further described by Baskerville and Kunz[3] and analysed by Schaller[2] and by Davis[1].

	SiO_2	Al_2O_3	Mn_2O_3	Li_2O	Na_2O	K_2O	CaO	MgO	NiO	MnO	ZnO	Ign.	
Schaller	64.42	27.32	0.15	7.20	0.39	0.03	--	--	--	--	--	none	= 99.61
Davis	64.05	27.30	--	6.88	0.30	0.06	0.80	none	0.06	0.11	0.44	0.15	=100.15

A few crystals of hiddenite and some masses of white spodumene have also been found at Pala, with the kunzite, Schaller[2].

Kunzite also occurs sparingly at the Victor mine, Rincon, in tabular crystals, some of them twinned as seen by the natural etch-figures. Forms: (100), (110), (010), (320), (130), (021), (111), ($\bar{1}$11), Rogers[3].

175. WOLLASTONITE.

Silicate of calcium, $CaSiO_3$.

Monoclinic. Generally in fibrous masses. Cleavage perfect orthopinacoidal. Color white, gray, rose. Vitreous luster. H=4.5—5.0; G=2.8—2.9.

Refractive indices: α=1.616; =β1.629; γ=1.631.

Fuses easily and quietly to a clear glass. Soluble in hydrochloric acid without usually gelatinizing.

Wollastonite is formed as a contact metamorphic mineral especially near the contact of eruptives with limestone. Usually found as compact fibrous masses either white or pink.

Alameda County: Some wollastonite has been found in the Berkeley Hills.

Del Norte County: White divergent masses found near Crescent City.

Lake County: White drusy wollastonite has come from Dry Creek, near Middletown. Specimens have come from near Glenbrook.

Napa County: Massive white occurs in Hunting Creek Canyon, near Knoxville.

Nevada County: White and pink are found as contact minerals at Grass Valley.

Riverside County: Fibrous, columnar and fine granular wollastonite occurs in the crystalline limestone at Crestmore as one of the contact

metamorphic minerals. An analysis of the fine granular by Eakle gave:

SiO_2	Fe_2O_3	CaO	H_2O	
51.77	2.12	44.85	1.02	= 99.76 per cent

An analysis of the crystals by Eakle gave:

SiO_2	CaO	MgO	Fe_2O_3	Ign
50.42	48.29	0.60	0.51	0.07 = 99.89%

Forms observed on the crystals were: (001), (100), (740), (540), (340), (140), (101), (104), ($\bar{1}$04), ($\bar{1}$03), ($\bar{1}$02), ($\bar{1}$01), (011), (744), (344), (144), ($\bar{7}$44), ($\bar{3}$44), ($\bar{1}$44), (122), ($\bar{1}$22), (142), ($\bar{1}$42).

San Diego County: Large masses of divergent columnar wollastonite, pure white, occur near Boulevard and at Carrizo Gorge, near Jacumba.

Santa Barbara County: Divergent fibrous masses having a pale rose color have been found at Santa Ynez.

Siskiyou County: Fine divergent specimens occur in limestone on Salmon River, three miles above Sommes Bar.

Tehama County: Found at Glenbrook Lake.

Trinity County: White fibrous occur near Hyampom.

Tulare County: Specimens have come from Upper Tule River.

Tuolumne County: Found on North Mokelumne River near Bear Creek and analysed by Hillebrand, Turner[4].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
50.67	0.20	6.77	0.31	0.50	40.34	0.58	0.22	0.14

H_2O at 110°	H_2O ab. 110°	CO_2	
0.08	0.31	0.52	= 100.24%

176. PECTOLITE.

Basic silicate of calcium and sodium, $HNaCa_2(SiO_3)_3$.

Monoclinic. Generally fibrous massive. Cleavage perfect orthopinacoidal. Color white. Luster silky to vitreous. H = 5; G = 2.68 — 2.78.

Refractive indices: $\alpha = 1.595$; $\beta = 1.606$; $\gamma = 1.634$.

Easily fusible to a clear glass and easily soluble, sometimes yielding gelatinous silica. A small amount of water is obtained in a closed tube.

White fibrous pectolite occurs as veins and patches in altered basic dikes and flows, and in serpentinized rocks.

San Francisco County: Fibrous pectolite occurs as veins in an altered dike which interseeted the serpentine at Fort Point. Described and analysed by Eakle[1]. Forms: (001), (100), (540), (140).

SiO_2	Al_2O_3 Fe_2O_3	CaO	Na_2O	H_2O	
53.40	3.87	30.56	7.61	4.46	= 99.90 per cent

Tehama County: Large mass occurred in serpentine on Elder Creek and was analysed by Eitel, Preston[1].

SiO_2	Al_2O_3 Fe_2O_3	CaO	Na_2O	K_2O	
56.84	1.27	33.46	3.45	3.97	= 99.63 per cent

177. RHODONITE.

Silicate of manganese, $MnSiO_4$.

Triclinic. Crystals often large. Generally massive or in grains. Cleavage perfect prismatic. Color rose-red. Vitreous luster. H=5.5—6.5; G=3.4—3.68.

Refractive indices: $\alpha=1.726$; $\beta=1.730$; $\gamma=1.737$.

Gives a violet or wine-colored bead with borax. Insoluble, but fusible to a black glass.

The manganese silicate is often present in copper and silver veins where oxide of manganese is abundant and it is usually associated with pyrolusite or psilomelane. It is generally developed as a contact mineral in veins.

Alameda County: Some rhodonite occurs at the Corral Hollow deposit.

Butte County: Found on the north fork of the Feather River with rhodochrosite. Occurs with psilomelane and pyrolusite one mile north of forks of Butte.

Fresno County: Pink rhodonite occurs with black oxides near Dunlap.

Glenn County: Occurs with psilomelane on Elk Creek.

Humboldt County: Observed near Orleans.

Madera County: Occurs near Coarse Gold with rhodochrosite and black oxides of manganese.

Placer County: Occurs with rhodochrosite near Forest Hill.

Plumas County: Considerable manganese occurs in the Genessee, Meadow, and other valleys and canyons of the county, and some good red rhodonite has come from them. Occurred with copper at the Diadem Lode, Meadow Valley, Hanks[5], Turner[4]. Good gem quality occurs near Taylorsville.

Riverside County: Specimens associated with pyrolusite and psilomelane near Elsinore.

Siskiyou County: Fine specimens of rhodonite occur at Sawyer's Bar. Rhodonite partly altered to the black manganese oxides occurs near Gazelle and on south fork of Salmon River. Specimens have come from Empire Creek, also Dutch Creek near Goltville. Massive and of good red color suitable for gem purposes occurs on Indian Creek near Happy Camp.

Tulare County: Some good gem rhodonite occurs about three miles north of Lemon Cove.

Tuolumne County: Found with pyrolusite on Rose Creek, near Columbia. Occurs as veins altering to the black oxides two miles north of Sonora.

AMPHIBOLE GROUP.

178. ANTHOPHYLLITE.

Silicate of magnesium and iron, $(Mg,Fe)SiO_3$.

Orthorhombic. Commonly lamellar or fibrous. Cleavage perfect prismatic. Color brownish gray, brownish green. Vitreous luster. H = 5.5 — 6; G = 3.1 — 3.2.

Refractive indices: $\alpha = 1.633$; $\beta = 1.642$; $\gamma = 1.657$.

Infusible, but blackens on heating. Insoluble in acids.

Anthophyllite is a metamorphic mineral occurring in schists and gneisses. It is usually found in fibrous and bladed masses, and is not uncommon, but has seldom been mentioned.

Contra Costa County: Fibrous masses of anthophyllite occur in the schists near San Pablo and the mineral has been analysed by Blasdale[1].

The analysis shows the mineral to be somewhat serpentinized.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°
33.66	1.36	0.34	4.80	38.70	0.48	0.98	0.24	19.79

MnO tr. = 100.26 per cent

Riverside County: Occurs associated with tremolite and actinolite on Eagle Mountains.

San Bernardino County: Occurs in the Slate Range, Hanks[6].

179. AMPHIBOLE.

Silicate of calcium and magnesium, $CaMg_2(SiO_3)_4$ with or without isomorphous mixtures of Fe, Al and Na.

Monoclinic crystals, columnar, fibrous, granular. Cleavage perfect prismatic. Color white, gray, green, brown, black. Vitreous luster. H = 5 — 6; G = 2.9 — 3.4.

Insoluble in hydrochloric acid. Tremolite fuses quietly at 4 to practically a colorless glass. Actinolite fuses to a greenish or brownish globule. Hornblende fuses to a black mass and gives a slight yellowish flame.

The amphiboles are similar to the pyroxenes, and, like them, are very important rock-forming minerals. They occur in metamorphic and igneous rocks, and the common varieties are to be found in every county. There are numerous varieties and those found in the State will be briefly mentioned.

Tremolite. Lime-magnesia amphibole, $CaMg_2(SiO_3)_4$. Common as a metamorphic mineral in schists and crystalline limestones in white or gray long prismatic and fibrous aggregates.

Refractive indices: $\alpha = 1.609$; $\beta = 1.623$; $\gamma = 1.635$.

Asbestos is a soft fibrous form of amphibole having the composition of tremolite or actinolite. Much of the asbestos of the State is, however, serpentine-asbestos, which is a hydrous form of magnesium silicate.

Mountain cork and *Mountain leather* are cork-like and leathery masses of tremolite.

Actinolite. Lime-magnesia-iron amphibole, $Ca(Mg,Fe)_3Si_4O_{12}$. Very abundant in the schists of the Coast Ranges and Sierras. Generally found in reticulated long prismatic crystals, sometimes fibrous. Color is bright grass green to dark green.

Refractive indices: $\alpha = 1.611$; $\beta = 1.627$; $\gamma = 1.636$.

Smaragdite is an emerald-green foliated variety of actinolite.

Cummingtonite is an iron-magnesia amphibole similar to anthophyllite.

Uralite is an amphibole derived by the alteration of pyroxene. The process of change from pyroxene to amphibole is called "uralitization."

Asbeferrite is a variety of tremolite.

Edenite is a light green aluminous variety of amphibole.

Hornblende. A lime-magnesia-iron-alumina amphibole similar to augite in its general composition.

Refractive indices: $\alpha = 1.629$; $\beta = 1.642$; $\gamma = 1.653$.

Hornblende is the commonest of the amphiboles and is found in large cleavage masses to fibrous. Common color is black to very dark green, sometimes brown. Hornblende is characteristic of the acid and intermediate eruptive rocks while augite is characteristic of the basic. Hornblende forms large areas of schists or amphibolites and is also a constituent of granite, syenite, diorite, rhyolite and trachyte. Less common in gabbro, diabase and basalt.

Soretite is an amphibole showing some optical differences from hornblende.

Pargasite is an amphibole between hornblende and glaucophane in composition, but is generally classed as hornblende.

Carinthine is an amphibole between hornblende and glaucophane in composition.

Amador County: Sheets of mountain leather with mountain cork have been found at the Little Grass Valley mine, Pine Grove. Some asbestos occurs near Oleta.

Butte County: Hornblende is the most abundant constituent of a quartz-amphibole diorite on ridge between this and Plumas counties and has been analysed by Valentine, Turner[4],[5].

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O
50.08	0.76	7.97	0.16	2.69	6.71	0.49	11.31	16.31	1.22

K_2O	H_2O	P_2O_5	
0.46	1.40	tr.	99.46 per cent

Tremolite asbestos occurs in limestone on Berry Creek. Reported from near Blinzig.

Calaveras County: Massive black hornblende in large crystals occur in the country rock of the Shenandoah mine, ten miles northeast of San Andreas. Actinolite is common near Valley Springs.

Contra Costa County: Tremolite and actinolite are common in the schists north of Berkeley and near San Pablo, and have been analysed by Blasdale[1].

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°	
Tremolite	56.68	1.79	1.70	2.23	19.35	15.80	--	--	0.10	2.25	=99.90%
Actinolite	55.21	3.45	--	7.49	18.97	10.50	2.45	--	--	1.75	=99.86
	55.56	2.05	--	5.97	19.45	12.13	1.94	0.30	--	2.58	=99.98

Del Norte County: Tremolite is found near Diamond Creek.

El Dorado County: Large cleavage masses of black hornblende occur with orthoclase, bornite, molybdenite, epidote and axinite at the old Cosumnes Copper mine near Fairplay. Bladed crystals of green actinolite occur in the schists near Latrobe. Short white fibers as asbestos occur near Georgetown.

Fresno County: Large crystals of hornblende in massive hornblende rock occur at the Cinnamon Bear mine near Pine Flat. Asbestos is reported to occur thirty miles east of Sanger.

Humboldt County: Massive hornblende occurs west of Three Creeks near Horse Mountain. Actinolite schist with chlorite occurs at Briceland.

Inyo County: Masses of mountain cork are found in the Swansea district and in Craig's Canyon on the east slope of the Inyo Mountains.

Kern County: Mountain leather occurs near Keene. Actinolite and tremolite occur in schists near Randsburg. Large columnar, brittle tremolite occurs at Toll Gate Canyon. Mountain cork occurs at the Tom Reed mine.

Los Angeles County: Crystalline masses of tremolite occur in calcite in Upper San Gabriel mining district.

Madera County: Asbestos occurs at the Savannah mine, Grub Gulch, and at the Baker mine near Coarse Gold. Actinolite schists carrying pyrrhotite and chalcopyrite occur at the Heiskell mine.

Marin County: Actinolite is common in the lawsonite schist of Reed Station. Massive black hornblende occurs near Reed Station in close proximity to the lawsonite.

Mariposa County: Hornblende is a constituent of: 1, the gabbro of Beaver Creek, near Big Trees; and, 2, of a quartz-monzonite on Tioga road, southeast of Mount Hoffman, Turner[4][7]. The first has been analysed by Valentine and the second by Hillebrand.

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Fe_2O_3	FeO	MnO	NiO	CaO	MgO
1.	46.08	0.77	10.56	--	2.81	8.30	0.15	--	12.64	14.40
2.	47.49	1.21	7.07	0.04	4.88	10.69	0.51	0.02	11.92	13.06

	Na_2O	K_2O	Li_2O	H_2O at 100°	H_2O ab. 100°	P_2O_5	F		
	1.62	0.34	none	0.17	1.97	0.18	none	= 99.99%	
	0.75	0.49	tr.	--	1.86	none	0.06	=100.05	O=F —0.02=100.03

Some asbestos occurs east of the Mariposa Grant. Large crystals of hornblende as rock masses occur near El Portal.

Mendocino County: Actinolite occurs at Calpella. Large masses of good actinolite prisms occur near Potter Valley.

Mono County: Long prisms of hornblende occur in the cavities of lava near Bridgeport, with forms: (001), (010), (100), (110), ($\bar{2}$01), (021), ($\bar{1}$31), Schaller[6].

Monterey County: Actinolite is found in schists near Soledad.

Napa County: Tremolite occurs in Chiles Valley.

Nevada County: Hornblende occurs in large crystals in the granodiorite of Nevada City and Grass Valley, Lindgren[6]. Uralite is common in the diorite of this locality. Large cleavage prisms of hornblende in schist occur in the Birchville district.

Placer County: Large masses of asbestos are found at Wisconsin Hill and Arizona Flat. Long white fibers of asbestos occur one-quarter mile east of Iowa Hill. Long silky fibers of light green to white asbestos are found south of Towle.

Plumas County: Edenite is a constituent of the plumasite of Spanish Peak, Lawson[3]. Actinolite and hornblende occur at Engels as rock constituents. Good-fibered asbestos occurs at the Fireproof Asbestos mine near Sloat. Green asbestos is found near Spring Garden.

Riverside County: Actinolite, tremolite and anthopyllite occur in the schist of Eagle Mountains. A good deposit of asbestos is reported fifteen miles southeast of Palm Springs. Black hornblende is a constituent of the grano-diorite at Crestmore. Some tremolite has also been found.

San Benito County: Actinolite occurs in the veins and wall-rock in capillary bunches at the benitoite locality, Louderback[2]. Good specimens at Tres Pinos.

San Bernardino County: Cummingtonite has been found near Daggett, with calcite. Asbeferrite occurs at Halleck. Coarse fibered tremolite occurs in the Oro Grande district.

San Diego County: Large crystals of black hornblende forming rock masses occur four miles east of Fallbrook. Also large crystals near Mexican line.

San Francisco County: Actinolite occurs in the schists on Angel Island.

Santa Clara County: Actinolite, smaragdite, soretite, pargasite and caranthine occur in the eclogites of Oak Ridge and Calaveras Valley, Margocci[1], J. P. Smith[1]. Specimens twelve miles east of Gilroy. Fibrous tremolite is found near Morgan Hill.

Shasta County: Long fibrous white tremolite or asbestos occurs in the Stock Asbestos mine near Sims.

Sierra County: Long fibers of asbestos occur on Goodyear Bar Creek.

Siskiyou County: Tremolite asbestos occurs in the Blue Ledge mining district.

Sonoma County: Large crystals of actinolite occur in foliated talc, near Petaluma. Mentioned by W. P. Blake[9]. Smaragdite occurs in the glaucophane-gneiss near Santa Rosa, Murgoci[1]. Actinolite is common with glaucophane at Camp Meeker. Coarse actinolite prisms occur on Hasey Ranch, west of Cloverdale.

Trinity County: Massive hornblende occurs near Wildwood and Otto Rest. Large crystals are found near Trinity Center and Douglas City.

Tulare County: Asbestos occurs near Globe and near Porterville. Tremolite and hornblende occur at the White Chief mine.

Tuolumne County: White fibrous tremolite occurs in the marble near Columbia; asbestos near Chinese Camp and Montezuma; mountain cork at Sawmill Flat and on Table Mountain.

Yuba County: Small amounts of tremolite asbestos occur near Challenge.

180. GLAUCOPHANE—Blue Hornblende.

Silicate of sodium, aluminium, iron and magnesium, essentially $NaAl(SiO_3)_2$ $(Fe,Mg)SiO_3$.

Monoclinic. Generally fibrous massive. Cleavage perfect prismatic. Color deep blue to bluish black. Streak grayish blue. Strongly pleochroic. Vitreous luster. H = 6 — 6.5; G = 3.1.

Refractive indices: $\alpha = 1.621$; $\beta = 1.638$; $\gamma = 1.638$.

Fuses quietly and yields a strong yellow flame of sodium. Insoluble in acid.

Glaucophane is a constituent of schists and gneisses which have been formed by metamorphism of igneous rocks containing a high percentage of sodium. Extensive areas of glaucophane rocks exist in California along the Coast Range and they have been described by Becker[1], Ransome[2], Lawson[1], Palache[3], J. P. Smith[1], Murgoci[1], Hanks[6], and others.

Crossite. This name was given by Palache[3] to a mineral which differed from glaucophane in its optical orientation and with a composition between it and riebeckite.

Refractive indices: $\alpha = 1.657$; $\beta = 1.659$; $\gamma = 1.663$.

Contra Costa County: The glaucophane from the schists near San Pablo was analysed by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	MnO	
54.52	9.25	4.44	9.81	10.33	1.98	7.56	0.16	1.78	0.39	0.46	=100.68%
52.39	11.29	3.74	9.13	11.37	3.03	6.14	tr.	2.57	0.14	tr.	= 99.80

Crossite was found in a boulder on the hillside north of Berkeley and was described by Palache[3] as a new amphibole, with analysis by W. S. T. Smith.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	
55.02	4.75	10.91	9.46	tr.	9.30	2.38	7.62	0.27	undet.	=99.70%

Fresno County: Common in the Coast Range from Coalinga to Livermore Pass.

Humboldt County: Occurs above Orleans on Klamath River and on east side of Jacoby Creek above Bayside.

Lake County: Masses have been found in the mountains near Upper Lake.

Marin County: Common in the schists near Reed Station.

Mendocino County: Common near Calpella. With hornblende, biotite and quartz at Long Vale.

Monterey County: In the schist near Pleyto.

Napa County. In schist near Calistoga.

San Benito County: A glaucophane resembling crossite occurs in the natrolite vein carrying the benitoite near the headwaters of the San Benito River, and was analysed by Blasdale, Louderback[2].

SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°	
52.94	3.76	13.40	1.44	11.54	5.45	5.11	0.43	1.31	3.72	=99.10%

San Francisco County: In the schist of Angel Island.

Santa Clara County: Murgoci[1] mentions glaucophane as a constituent of eclogite, quartzite, mica schist and greenstone in the Calaveras Valley.

Sonoma County: Associated with actinolite, garnet, epidote and quartz in schist near Healdsburg. Also at Camp Meeker and near Petaluma.

Stanislaus County: In schist east of Red Mountain.

Trinity County: Occurs near Hayfork.

181. CROCIDOLITE.

Silicate of sodium and iron, essentially $NaFe(SiO_3)_2.FeSiO_3$.

Monoclinic. Usually fibrous. Cleavage perfect prismatic. Color deep blue or green. Vitreous luster. H=4; G=3.2—3.3. Pleochroic. Refractive index: β=1.70.

Fuses with slight intumescence to a black magnetic mass and colors the flame yellow. Insoluble in acid.

A rock-forming mineral similar to the amphiboles and glaucophanes but not so common.

Cataphorite is a soda-iron crocidolite between berkevikite and arfvedsonite in optical characters.

Lake County: Fibrous veins of blue crocidolite are said to occur in schist near Lakeport.

Monterey County: Occurs in schist near Pleyto.

Plumas County: Crocidolite and cataphorite occur in the syenite of Spanish Peak, Murgoci[1].

Santa Clara County: Cataphorite is a constituent of diorite at Oak Ridge, Calaveras Valley, Murgoci[1]. Crocidolite occurs as bluish fibrous seams in metamorphic rock east of Mount Hamilton, and an analysis of it by A. K. Schellinger is given by Rogers[5].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O (by diff.)	H_2O
50.65	0.90	19.21	21.70	0.79	0.39	4.93	1.43

NOT GROUPED.

182. BERYL.

Silicate of beryllium and aluminium, $Be_3Al_2Si_6O_{18}$.

Hexagonal. Prismatic crystals, sometimes very large. Color green, blue, rose, yellow. Vitreous luster. H = 7.5 — 8; G = 2.63 — 2.80.

Refractive indices: $\epsilon = 1.564$; $\omega = 1.568$.

Whitens and is very difficult to fuse, yielding an enamel. Insoluble in acid.

Beryl is found as crystals varying greatly in size in acid pegmatite veins, generally. Most of the beryl known to occur in the State is limited to the series of feldspathic pegmatite veins of Riverside and San Diego counties, in which the beautiful gem tourmalines occur. Transparent aquamarine, golden, deep green and blue crystals, forming beautiful gems when cut, occur in these pegmatites.

El Dorado County: Rich green emerald beryl has been found near Georgetown. The crystals are most too small to cut as gems.

Fresno County: Beryl is said to be associated with the feldspar five miles northeast of Trimmer.

Riverside County: Fine yellow and green beryls occur at Coahuila and rose crystals near Hemet.

San Bernardino County: Blue and green beryl is found in northern part of county.

San Diego County: Yellow, green and blue crystals occur in the Palomar Mountains, nine miles southeast of Pala: Some rose, yellow and green occur at Pala and Mesa Grande. Green crystals from Rincon have the forms: $(10\bar{1}0)$, (0001), $(10\bar{1}1)$, $(11\bar{2}0)$, $(11\bar{2}1)$, $(21\bar{3}0)$, $(11\bar{2}2)$, $(13.1.\bar{14}.1)$ and rose crystals the forms: $(10\bar{1}0)$, $(11\bar{2}1)$, $(10\bar{1}1)$, (0001), $(21\bar{3}1)$, Eakle[6]. Mentioned by Kunz[7], Schaller[4], and Rogers[2].

Pink beryl occurs at Katrina mine, Pala. Golden beryl one mile northwest of Jacumba. Gem beryl at Crystal Gem mine, eight miles northwest of Jacumba. Fine, large crystals from Aguanga Mountain,

Golden and aquamarine at the Esmeralda mine. Fine crystals at the Surprise, A B C, Hercules and Lookout mines, Ramona.

Tuolumne County: W. P. Blake[1] reported beryl from near Jamestown.

183. NEPHELITE—Eleolite.

Silicate of aluminium, sodium and potassium. $K_2Na_6Al_8Si_9O_{34}$.

Hexagonal. Generally massive, compact as a rock constituent. Color greenish gray to brown. H=5.5—6; G=2.55—2.65. Luster greasy.

Refractive indices: $_{\epsilon}$=1.538; $_{\omega}$=1.542.

Fuses quietly to a colorless glass and colors the flame yellow on account of the large amount of sodium present. Gelatinizes with hydrochloric acid.

Nepheline rocks are apparently very rare in California since they have never been reported in petrographical literature.

Tulare County: Found as a constituent of a boulder of fine-grained gray syenite along the Strathmore-Lindsay Canal.

184. SODALITE.

Silicate of sodium and aluminum with chlorine. $3\,NaAlSiO_4.\,NaCl$.

Isometric. Usually massive. Brittle. Color blue to gray. H=5.5—6: G=2.14—2.30.

Refractive index: n=1.483.

Becomes white on heating and fuses with intumescence to a colorless glass. Soluble in hydrochloric acid, yielding gelatinous silica. Dissolved in nitric acid, and adding silver nitrate, silver chloride is precipitated.

Los Angeles County: The optical properties of the so-called lazurite from San Antonio Creek indicate that it is sodalite and not lazurite.

185. NOSEAN—Noselite.

Silicate of sodium and aluminium with sodium sulphate, $Na_4(NaSO_4.Al)Al_2(SiO_4)_3$.

Isometric. Granular. Color gray, blue, brown. H=5.5; G=2.25—2.4.

Refractive index: n=1.495.

Easily fusible and is easily soluble, yielding gelatinous silica. Barium chloride added to a hydrochloric acid solution will precipitate barium sulphate. Fuses with intense yellow flame.

A rare rock-forming mineral characteristic of nepheline rocks which have not been reported in the State.

San Bernardino County: There is a specimen of nosean rock from Calico exhibited in the museum of the State Mining Bureau.

186. LAZURITE—Lapis-Lazuli.

Silicate of sodium and aluminium with sodium sulphide, $Na_4(NaS_3.Al)Al_2(SiO_4)_3$.

Isometric. Massive. Color deep azure-blue or violet-blue. Vitreous luster. H = 5 — 5.5; G = 2.38 — 2.45.

Refractive index: $n = 1.50$.

Gelatinous and reacts similar to noselite. A faint odor of hydrogen sulphide may be detected when treated with hydrochloric acid.

The blue ornamental mineral lapis-lazuli is rare, and is only definitely known to occur in one locality. A blue lazulite and a blue dumortierite have been erroneously reported as lazurite.

Los Angeles County: Small boulders of limestone containing lapis-lazuli with pyrite occur in the bed of San Antonio Creek, near Uplands. The boulders come from an old prospect which was thought to be a silver deposit. It occurs on the north slope of south fork of Cascade Canyon, 1½ miles east of the "Hogback" in San Antonio Canyon, twelve miles from Upland. The occurrence has been described as lapis-lazuli by Surr[1].

Madera County: Specimens are said to have been found in the Minaret Mountains.

San Bernardino County: A small boulder of gray limestone containing lapis-lazuli, pyrite, diopside and an unknown mineral was reported as coming from this county by Rogers[5]. It is possibly a stray boulder from the Los Angeles deposit.

187. GARNET.

Silicate of Ca,Mg,Al,Fe,Cr,Mn, etc., forming several varieties.

Isometric. Rhombic dodecahedrons and trapezohedrons very common. Also compact to granular massive. Color generally some shade of red; often yellow, brown, green, black, and white. Vitreous luster. H = 6.5—7.5; G = 3.15 — 4.3.

Most garnets are fusible at about 3 to a brownish glass, but are insoluble. The iron garnets, almandite and andradite, become magnetic when fused and are slightly soluble, yielding a small amount of gelatinous silica. Uvarovite is infusible, but yields a chromium bead with borax. Spessartite yields a manganese bead with borax. The bases of most garnets can best be determined by wet methods, that is: precipitation of each from solution by reagents.

Garnet is one of the very common minerals of the State and probably all of the known varieties occur. It is generally a product of metamorphism and is common in metamorphic rocks such as gneiss, schist, quartzite and crystalline limestone. As a contact mineral formed by the intrusion of igneous rock into limestone and other rock it is often found in fine large crystals. Common constituent of beach sands and of the concentrates of mining districts. There are several varieties based on composition.

Grossularite, essonite, hyacinth, cinnamon stone. Lime-alumina garnet, $CaAl_2Si_3O_{12}$. Common as a contact mineral in crystalline limestone. Generally a light shade of red or green, sometimes almost white, and when clear forms a valued gem.

Refractive index: $n=1.735—1.763$.

Pyrope. Magnesia-alumina garnet, $Mg_3Al_2Si_3O_{12}$. Occurs usually in serpentine and peridotite. Deep blood-red color.

Refractive index: $n=1.705—1.742$.

Almandite. Iron-alumina garnet, $Fe_3Al_2Si_3O_{12}$. Common garnet of gneisses and schists. Brownish red and sometimes of gem value.

Refractive index: $n=1.778—1.830$.

Andradite. Lime-iron garnet, $Ca_3Fe_2Si_3O_{12}$. Common garnet of gneisses and schists. Rarely clear enough for gems.

Refractive index: $n=1.865—1.895$.

Topazolite. Lime-iron garnet, $Ca_3Fe_2Si_3O_{12}$. Occurs usually in crystalline limestone and schist. Yellow garnet.

Spessartite. Manganese-alumina garnet, $Mn_3Al_2Si_3O_{12}$. Occurs usually in pegmatite veins. Light rose shade.

Refractive index: $n=1.800—1.811$.

Uvarovite. Chrome garnet, $Ca_3Cr_2Si_3O_{12}$. Generally found as crystals coating massive chromite. Color emerald-green.

Refractive index: $n=1.838$.

Trautwinite, which was described as a new mineral by Goldsmith[1], appears to be a mixture of uvarovite and chromite.

Alpine County: The old Rogers copper claim in Hope Valley was located in garnet rock. W. P. Blake[9] reported fine green grossularite from this valley.

Butte County: Red and brown garnet was common in the sands of the gold washings at Cherokee, Silliman[7].

Calaveras County: Found at Bald Point on Mokelumne River; in the gravels of San Andreas. Good crystals of andradite in schist at the Shenandoah mine.

Del Norte County: Common in the sands at Crescent City, Gilbert Creek, Smith River.

El Dorado County: Large crystals of grossularite have been found at the old Cosumnes copper mine. Good crystals nine miles southeast of Placerville. Massive at Pilot Hill, W. P. Blake[9]. Common near Georgetown. At the Lilyoma mine, Pilot Hill, crystals occur associated with chalcopyrite, galena, calcite and quartz. Grossularite occurs with calcite, specular hematite, pyrite and chalcopyrite at the Rodgers mine, in eastern part of county.

Fresno County: Occurs at Grub Gulch and Fort Miller. The limestone near Trimmer contains much garnet. Brown garnet is associated with green tourmaline on Spanish Peak in a ledge of white quartz. Near Dunlop in crystals. Found near Spanish Mountain. In calcite at San Ramon a white opaque garnet occurs with the green californite, on south side of Watt Valley. Associated with galena and chalcopyrite at the Fresno Chief mine.

Humboldt County: Common in the sands at Gold Bluff and Orleans. In chlorite schist at Big Lagoon.

Inyo County: Crystals and massive garnet are found in the Coso and Inyo mountains. Fine large crystals of grossularite occurred associated with white massive datolite and greenish brown vesuvianite at the San Carlos mine and the mineral was analysed by J. L. Smith[1].

SiO_2	Al_2O_3	Fe_2O_3	MnO_2	CaO	MgO		
42.01	17.76	5.06	0.20	35.01	0.13	=100.17%	G=3.59

Andradite occurs with epidote and scheelite in Deep Canyon eight miles west of Bishop. This deposit was described by Knopf[3]. Common in limestone at contact with aplite at the Green Monster mine. As a contact metamorphic mineral in limestone in Majourka Canyon.

Kern County: Massive near Hot Springs between Havilah and Kernville and on summit between Walker's Basin and Havilah. Sand garnet is abundant at Soapstone Mountain.

Lassen County: Common at the Diamond mine.

Los Angeles County: In sands at Mount Meadows.

Madera County. Common in the Hildreth district and at Mt. Raymond. Garnet rock carrying galena occurs at the De Sota mine, North Fork mining district.

Marin County: Andradite crystals are common in the schist of the Tiburon Peninsular.

Mariposa County: Massive brown almandite occurs on Mount Hoffman. Good crystals are found at the junction of Moore Creek and Mokelumne River.

Mendocino County: Common in the sands at Fort Bragg. The green uvarovite coats chromite about twelve miles north of Willets.

Monterey County: Common in the sands of the Los Burros district. Uvarovite has been found coating chromite in the county. Trautwinite, which was described as a new mineral by Goldsmith[1], from this county, appears from the analysis to be a mixture of uvarovite and chromite.

SiO_2	Cr_2O_3	Fe_2O_3	Al_2O_3	CaO	MgO	Ign.		
21.78	38.39	13.29	0.81	18.58	7.88	0.11	=100.84%	G=3.505

Pyrope garnet occurs in granitic rock on Naciemento River.

Nevada County: In the concentrates of the Rough and Ready district. With wollastonite at Grass Valley, Lindgren[6]. Fine green crystals

coat the chromite at the Red Ledge mine, two miles southwest of Washington, associated with rhodochrome and kämmererite.

Orange County: A constituent of the schists near Anaheim. Pale apple-green pebbles of grossularite were found near El Toro and analysed by Steiger, Clarke[3].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Alk	P_2O_5	Ign.		
37.54	tr.	22.84	0.79	0.26	36.66	0.44	0.13	tr.	1.74	=100.40%	G=3.485

Placer County: Essonite is found at Deer Park, and on the American River near Towle. Uvarovite has been found on chromite near Auburn. Andradite with epidote anthophyllite, augite and chalcopyrite occurs in the magnetite deposit at Hotaling. Fine uvarovite crystals have been found on chromite, seven miles southeast of Newcastle at Farmer Swanton mine, with rhodochrome and kämmererite.

Plumas County: In sands at Nelson Point and at the Good Hope mine. Oily green grossularite occurs at the Good Hope mine. Found with epidote and the copper sulphides at the Duncan mine, Genessee district, at contact of limestone and granodiorite. Occurs near Portola in quartz rock.

Riverside County: One of the minerals in the concentrates at Holcomb. Occurs massive at the Santa Ana tin district. Hyacinth or essonite is found at Hemet. Abundance of grossularite and some andradite garnet occurs in the crystalline limestone at Crestmore, associated with vesuvianite, diopside and wilkeite. An analysis of the grossularite by J. Buford Wright gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CuO	CaO	MgO	Na_2O	H_2O		
35.52	21.11	3.95	0.60	0.70	36.06	0.78	0.20	1.23	=100.15%	G=3.39

Essonite or hyacinth garnet occurs with tourmaline in fine crystals at Coahuila. Near Mecca in considerable quantity.

San Benito County: Fine green crystals were found coating chromite and rhodochrome at New Idria, Brush[1].

San Bernardino County: Found with epidote and calcite in the iron ores at Dale. Red garnet and green epidote in the Cajon Pass.

San Diego County: Fine crystals of transparent essonite garnet are found in the tourmaline districts of Mesa Grande, Pala and Rincon and these have been extensively cut into gems under the name "hyacinth." Essonite also occurs about ten miles east of Jacumbe Hot Springs with vesuvianite and quartz. Garnet is found in the Julian district and at Ballina. Spessartite was reported from Mesa Grande but it may have been essonite. Fine granular red at Rincon, Rogers[2]. Essonite or hyacinth in good crystals from the Hercules, Surprise, Lookout and Prophet mines at Ramona. Occurs also near San Vincente. Massive garnet used for sandpaper occurs at the McFall mine, 7½ miles southeast of Ramona. Some essonite is found near Banner. With vesuvian-

ite and calcite at Boulevard. Almandite in mica schist on San Margarita Ranch. Massive from the Dos Cabezas district.

Santa Barbara County: Common in the sands at Point Sal.

Santa Clara County: A constituent of the eclogites of Calaveras Valley, Murgoci[1]. Analysed from the omphacite-eclogite of Coyote Creek by W. O. Clarke, J. P. Smith[1].

SiO_2	Al_2O_3	FeO	MgO	CaO	
38.69	19.10	26.81	5.07	10.64	=100.38%

Shasta County: Uvarovite has been found on chromite on Shotgun Creek. Red garnet on Round Mountain. Bands of garnet mixed with pyroxene occur on McCloud River on contact between diabase and carboniferous limestone. Yellow garnet occurs with epidote near Castella.

Siskiyou County: In sands at Cecilville and on Klamath River. Uvarovite coats chromite near Callahan at the Martin McKean mine.

Sonoma County: Large masses of garnet occur near Petaluma, W. P. Blake[9]. Almandite garnets occur abundantly in a chlorite schist on the Cox ranch, three miles west of Healdsburg. Grossularite is said to occur near Petaluma. Garnets in schist near Gualala. With glaucophane and actinolite in schists at Camp Meeker and near Healdsburg. Almandite garnets occur in chlorite schist west of Healdsburg.

Trinity County: Emerald green crystals of uvarovite occur on chromite near Carrville. Andradite occurs at Peanut. Found in limestone with epidote at Red Mountain. Colorless grossularite occurs associated with epidote, titanite and zircon in a soda granite-porphyry in the Iron Mountain district.

Tulare County: White massive grossularite was found in the northwest corner of the county, which was analysed by Steiger, Kunz[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	MnO	H_2O at 100°	H_2O ab. 100°
38.59	--	22.24	0.45	0.36	35.97	0.64	0.10	0.31	0.80
						CO_2 0.39	F 0.17	=100.02%	

Essonite in good crystals occurs at Three Rivers. Topazolite was found at the Old Soldier mine, Drum Valley, twelve miles northeast of Visalia. Aplome, a manganese andradite, was found near Visalia. Occurs with tremolite on North Tule River. With quartz and epidote on Kaweah River, twenty-five miles northwest of Exeter.

Tuolumne County: With epidote at Mutton ledge; in schist on Jarvis Ranch and at Soulsbyville. Occurs with quartz east of Columbia.

Ventura County: Abundant in sands in Piru district. Garnets with the forms: (110) and (211) occur in the Piru Mountains.

188. MONTICELLITE.

Silicate of calcium and magnesium, $CaMgSiO_4$.

Orthorhombic. Usually massive or in grains. Color yellowish gray or light brown. H = 5 — 5.5; G = 3.03 — 3.25.

Refractive indices: $\alpha = 1.651$; $\beta = 1.662$; $\gamma = 1.668$.

Almost infusible, but soluble with gelatinization. Magnesium can be precipitated from a solution after all silica and calcium have been removed.

A rare mineral formed by contact metamorphism in a magnesian limestone.

Riverside County: One of the many minerals occurring in the crystalline limestone at Crestmore. It was found massive and in isolated grains in the blue calcite, associated with xanthophyllite. Analysed by Eakle[10].

SiO_2	FeO	CaO	MgO	
37.26	3.35	34.26	24.74	= 99.61%

189. OLIVINE—Chrysolite—Peridot.

Silicate of magnesia and iron $(Mg,Fe)_2SiO_4$.

Orthorhombic. Generally in grains. Color olive-green, grayish green. Vitreous luster. H = 6.5 — 7; G = 3.27 — 3.37.

Refractive indices: $\alpha = 1.662$; $\beta = 1.680$; $\gamma = 1.699$.

Usually infusible, but whitens when heated and may become magnetic if much iron is present. Soluble in hydrochloric acid, yielding gelatinous silica.

Olivine is a rock-forming mineral which is practically limited to very basic eruptive rocks like diabase, basalt, andesite, gabbro and peridotite. Occurs occasionally in clear green crystals large enough to cut into gems.

Butte County: A constituent of diabase at Mooreville Ridge, Turner[1]. Also in the concentrates at Oroville and Cherokee.

Del Norte County: In the sands at Crescent City, Gilbert Creek and Smith River.

Humboldt County: In the beach sands at Gold Bluff and also in the sands at Orleans Bar and Trinidad.

Los Angeles County: Small amount is found in the sand at Ocean Park.

Mendocino County: Occurs in the sand at Fort Bragg.

Modoc County: Olivine is a constituent of the basalt near Cedarville.

Nevada County: In the gabbro-serpentine series at Grass Valley, Lindgren[6].

Plumas County: A constituent of plumasite at Spanish Peak, Lawson[3].

Riverside County: In basalts of Eagle Mountains.

San Bernardino County: Large bombs of granular olivine occur in the basaltic rocks of the Moronga district. Olivine bombs are common in the lavas along the State Highway near Amboy.

San Diego County: A constituent of the gabbro at Dehesa, Lawson[4].

San Francisco County: In the serpentine of San Francisco, Lawson[2], Palache[2].

San Mateo County: In the beach sands of the county.

Santa Cruz County: Small amount of the crystals in the sands at Aptos.

Siskiyou County: At the forks of the Salmon in sand.

Trinity County: Common constituent of the basic rocks west of Trinity River, Weaverville Quadrangle.

Yuba County: Quite a prominent constituent of the concentrated sands at Marysville.

190. TEPHROITE.

Silicate of manganese, Mn_2SiO_4.

Orthorhombic. Usually massive. Brittle. Color grayish-red to smoky-gray. Luster vitreous to greasy. H=5.5—6; G=4.1.

Refractive indices: $\alpha=1.759$; $\beta=1.786$; $\gamma=1.797$.

Fuses to a black mass. Soluble in hydrochloric acid with gelatinization. Gives manganese and usually iron reactions.

This is one of the rarer manganese minerals and only has been reported previously in this country from the zinc district of New Jersey, where it is rather abundant. Usually of contact metamorphic origin.

Santa Clara County: Grayish red tephroite in small residual masses occurred in the manganese boulder found near Alum Rock Park, five miles east of San Jose, Rogers[3].

191. IDDINGSITE.

Silicate of iron, magnesium, calcium and sodium.

Orthorhombic. Lamellar crystals. Cleavage perfect macropinacoidal. Color chestnut-brown to yellowish green. Bronze luster. H=2.5; G=2.84.

Refractive indices: $\alpha=1.70$; $\beta=1.72$; $\gamma=1.74$.

Gelatinizes with acid and becomes magnetic when heated.

Iddingsite is the name given by Lawson[1] to a new rock-forming mineral similar to olivine, found in basic eruptive rocks. Since its discovery the mineral has been observed in many other localities in the rock sections.

Los Angeles County: Occurs in basalt in the Santa Monica Mountains.

Monterey County: The mineral was first observed in reddish sections in the carmeloite (augite-andesite) at Carmelo Bay.

192. WILLEMITE.

Silicate of zinc, Zn_2SiO_4.

Hexagonal, rhombohedral. Crystals usually prismatic. Also massive and granular. Cleavage basal. Color light green, apple-green, flesh red. Vitreous luster. H=5.5; G=3.89 — 4.18.

Refractive indices: ϵ=1.723; ω=1.694.

Fuses to a white enamel. Soluble in hydrochloric acid, yielding gelatinous silica. On charcoal a coating, yellowish white, hot, and white when cold, is obtained, which turns yellowish-green when heated with cobalt nitrate.

Very little zinc has been found in the State except in the form of the sulphide and carbonate. Willemite is sometimes found with the more common calamine as a dehydrated product.

Inyo County: Found with calamine and hydrozincite at the Ygnacio and Cerro Gordo mines.

193. WERNERITE—Scapolite.

Tetragonal. Usually massive granular. Color white, gray or pink. H=5 — 6; G=2.66 — 2.73.

Refractive indices: ϵ=1.545; ω=1.567.

Fuses easily with slight intumescence to a white blebby glass. Slightly attacked by hydrochloric acid, but the fused beads are soluble with gelatinization. A yellow sodium flame is usually obtained.

Scapolite is the name given to a group of rock-forming silicates consisting of isomorphous mixtures of $Ca_4Al_6Si_6O_{25}$ with $Na_4Al_3Si_9O_{24}Cl$. Wernerite is the most common member of the group. The scapolites are in general formed by contact metamorphism.

Nevada County: Scapolite occurs in a contact schist at Nevada City and Grass Valley, Lindgren[6].

Riverside County: Scapolite occurs in association with green pyroxene, quartz, feldspar, wollastonite and grossularite garnet, at Crestmore. Occurs in small dikes with augite on Eagle Mountains.

194. GEHLENITE.

Silicate of calcium and aluminum, $Ca_2Al_2Si_2O_9$.

Tetragonal. Crystals and massive granular. Color gray to brown. Vitreous luster. H=5.5—6; G=2.9—3.07.

Refractive indices: ϵ=1.661; ω=1.666.

Practically infusible. Soluble in hydrochloric acid, forming a thick jelly.

A lime silicate formed by contact metamorphism of limestone. It is not known to occur in many localities.

Riverside County: Occurs in granular masses intimately associated with merwinite and spurrite and with diopside and wollastonite at the Crestmore limestone quarry. Its occurrence has been mentioned by Foshag[2].

195. MERWINITE.

Silicate of calcium and magnesium, $Ca_3Mg(SiO_4)_2$.

Monoclinic? Compact granular masses. Colorless to pale greenish. Greasy luster. H=6; G=3.150. Polysynthetic twinning.

Refractive indices: $\alpha=1.708$; $\beta=1.711$; $\gamma=1.718$.

A new mineral named and described by Larsen and Foshag[1]. A contact metamorphic mineral formed in limestone.

Riverside County: Occurs as granular masses associated with gehlenite, spurrite, wollastonite and an unknown mineral in the limestone quarries at Crestmore. Analysis of the mineral by Foshag gave:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	FeO	H_2O at 110°	H_2O Ign
35.50	0.66	None	49.96	11.62	1.22	0.12	0.94=100.02%

The mineral alters to thaumasite.

196. VESUVIANITE—Idocrase.

Basic silicate of calcium and aluminium, $H_4Ca_{12}(Al,Fe)_6Si_{10}O_{43}$.

Tetragonal. Square prisms, granular, massive. Color brown to green. Vitreous luster. H=6—6.5; G=3.35—3.45.

Refractive indices: $\epsilon=1.721$; $\omega=1.716$.

Fuses easily to a greenish or brownish glass. Insoluble, but the fused beads are soluble with gelatinization when powdered. The various bases can only be determined by precipitation from solution.

Vesuvianite is a characteristic mineral formed in limestone near the contact with intrusive rocks. It is often associated with grossularite garnet.

Californite. A very compact massive green vesuvianite, resembling jade, named by Kunz[4]. Occurs as streaks and nodules in serpentine.

Butte County: Good green californite occurs on the west side of the North Fork of Feather River, near Big Bar. It occurs as streaks and nodules in serpentine. Rogers[5] mentions some water-worn pebbles from the Feather River.

El Dorado County: Brown crystals of vesuvianite occurred at the Siegel Lode, W. P. Blake[9].

Fresno County: Californite occurs on east side of Watts Valley, about thirty-two miles east of Fresno. Californite is reported from Burro Valley.

Inyo County: Brownish green crystals were associated with garnet and massive white datolite at the San Carlos mine. Analysed by J. L. Smith[1].

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Ign.	
36.56	17.04	5.93	0.18	35.94	1.07	0.51	2.00	=99.23%

One of the minerals of contact metamorphic origin in the garnet-scheelite deposit at Deep Canyon; occurs with essonite in the Coso mining district.

Kern County: Small yellow crystals occur in white crystalline limestone in Jawbone Canyon.

Modoc County: Reported from the Willow Ranch with calcite.

Riverside County: Green and brown vesuvianite masses and crystals are common in the crystalline limestone at Crestmore, and were described by Eakle[10]. Forms observed on the crystals were: (001), (010), (110), (011), (111), (221), (331), (121), (131), (132), (154), and (285).

Analysed by J. Buford Wright: G=3.36.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CuO	CaO	MgO	Na_2O	H_2O
36.88	17.61	3.11	0.46	1.50	1.06	33.27	4.73	0.34	0.61=99.57%

San Diego County: Brown vesuvianite occurs with essonite garnet about ten miles east of Jacumba Hot Springs, Kunz[7]. Occurs near Boulevard associated with garnet.

Siskiyou County: The apple-green variety, *californite,* outcrops for about 200 feet along the south fork of Indian Creek, twelve miles from Happy Camp, and the mineral was analysed by Steiger, Kunz[4].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O at 100°	H_2O ab. 100°
35.86	0.10	18.35	1.67	0.39	0.05	33.51	5.43	0.29	4.18
					P_2O_5	CO_2	F		
					0.02	--	--	=99.85%	

This is the original locality of the variety. Found also near Hawkinsville and in small crystals on east shore of Miller Lake.

Tulare County: Californite is found in the chrysoprase locality east of Porterville. This variety occurs also with white grossularite garnet in the northwest corner of the county, about thirty-five miles east of Selma. Analysed by Steiger, Kunz[7].

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O at 100°	H_2O ab. 100°	CO_2
36.55	18.89	0.74	0.74	35.97	2.33	0.58	3.42	0.91
						F		
						0.13	=100.26%	

197. ZIRCON.

Silicate of zirconium, $ZrSiO_4$.

Tetragonal. Small prisms. Colorless, pink, grayish brown. Vitreous luster. H=7.5; G=4.68—4.7.

Refractive indices: ϵ=1.968; ω=1.923.

Infusible and insoluble. The zirconium reaction is obtained by dipping a strip of turmeric paper in a hydrochloric acid solution, which turns it an orange-red.

Zircon is an almost constant accessory mineral in the acid eruptive rocks, especially granites and syenites. The concentrates from the gold

washings and the black sands generally carry some zircon crystals, but there is no locality in the State known for "zircon sands."

Alameda County: Mentioned as one of the constituents of the soda-rhyolite of North Berkeley, Palache[2].

Butte County: First mentioned in the State by Silliman[7] as a constituent of the gold-washings at Cherokee. Has been observed in the sands at Oroville, Stirling City, Little Rock Creek and Brush Creek.

Calaveras County: In the sands at Douglas Flat and Wallace.

Del Norte County: At Crescent City, Gilbert Creek and Smith River.

El Dorado County: Sands of the Brownsville district, near Placerville and at Grizzly Flat.

Fresno County: In the sands at Picayune Flat.

Humboldt County: The beach sands at Gold Bluff and Upper Gold Bluff contain a little zircon. Also found at Orleans and Trinidad.

Marin County: In quartzite near Reed Station, Murgoci[1].

Mendocino County: Observed at Fort Bragg, in Anderson Valley, and on the Navarro River.

Nevada County: A constituent of the granodiorite of Nevada City, Lindgren[6]. Also in the concentrates at Nevada City, Grass Valley and Rough and Ready.

Placer County: Observed at Butcher Ranch and Gold Run.

Plumas County: In the Diadem Lode, Meadow Valley, Turner[4]. In the sands at Spanish Ranch and Rock Island Hill. A constituent of the norites at Engels.

Riverside County: Small amounts in the sands at Holcombe. Minute clove-brown crystals showing the forms: (100), (110), (111), (331), are scattered through some of the white pegmatite dikes at Crestmore. A constituent of the igneous rocks of Eagle Mountain.

Sacramento County: Common in the sands at Michigan Bar.

San Diego County: A constituent of the dumortierite schist at Dehesa, Schaller[5].

San Luis Obispo County: The beach sands at Port Harford and Pismo contain some zircon.

San Mateo County: The beach sands of the county show a little of the mineral.

Santa Barbara County: In the sands at Point Sal.

Santa Cruz County: At Aptos.

Shasta County: In the sands from French Gulch and Redding.

Siskiyou County: In the sands of Jackson Creek, Scott River, Salmon River and at Sawyer's Bar. Colorless and pale pink crystals from near Fort Jones have the forms: (100), (110), (101), (111), (311), (511), Eakle[1].

Trinity County: At Trinity Center, Burnt Ranch, Junction City, Minersville and in the sands of the streams.

Yuba County: In the sands of Camptonville.

198. TOPAZ.

Silicate of aluminium and fluorine, $Al(O,F_2)AlSiO_4$.

Orthorhombic. Prismatic crystals. Cleavage perfect basal. Colorless, aquamarine, yellow, blue. Vitreous luster. H=8; G=3.4 — 3.65.

Refractive indices: α =1.619; β=1.620; γ=1.627.

Infusible and insoluble. The powdered mineral ground with a few beads of phosphorous salt and heated in a bulb tube, will yield hydrofluoric acid which etches the glass and forms a white ring or coating of silicon fluoride. The powdered mineral moistened with cobalt nitrate and intensely heated, becomes sky-blue.

Topaz occurs in veins in metamorphic and eruptive rock where fluorine has accompanied the formation of the vein. It is usually associated with tourmaline and other minerals whose formation has been due to the action of gases on the constituents of the rock.

Butte County: Mentioned by Silliman[7] as a constituent of the sands at Cherokee. Probably mistaken for zircon.

Fresno County: At the feldspar deposit, five miles northeast of Trimmer it is said to occur, associated with beryl.

San Diego County: Fine large crystals of colorless and aquamarine topaz occurred at the Little Three and Sunrise mines, a few miles from Ramona. Some of them resemble the topaz from the Urals. Fine crystals, light green in color, occur in the Aguanga Mountains. Good bluish topaz resembling the Ural topaz has been found at the Mountain Lily mine, near Oak Grove.

199. ANDALUSITE—Macle—Chiastolite.

Silicate of aluminium, Al_2SiO_5.

Orthorhombic. Prisms. Color gray, pink, rose-red. Vitreous luster. H=7.5; G=3.16 — 3.20.

Refractive indices: α =1.632; β=1.638; γ=1.643.

Infusible and insoluble. The powdered mineral moistened with cobalt nitrate and heated, yields the alumina blue color.

Occurs as a constituent of gneisses and schists, and is usually associated with cyanite, sillimanite and staurolite.

Chiastolite is a variety found in carbonaceous schists, in knotty and long prismatic individuals having black inclusions of carbon arranged axially, and thus forming black crosses seen in the transverse sections.

Fresno County: Chiastolite occurs near Chowchilla Crossing on the old Fort Miller Road.

Kern County: Chiastolite schists occur on Walker's Creek southeast of Bakersfield.

Mariposa County: Chiastolite schists are abundant along the Chowchilla River and were first reported by W. P. Blake[1]. This variety was mentioned by Turner[1] from the Ne Plus Ultra mine, near Barenda, from the Daulton ranch near Indian Gulch and from Yaqui Gulch near

Mariposa. Small crystals occur in slate on Muller Ranch, near Hornitos. The chiastolite variety is found on Moore's Flat.

Mono County: Occurs as a large coarsely granular mass in the southern part of the county on the northern part of White Mountains. Deep blue lazulite and specular hematite are associated, Knopf[5].

Nevada County: Andalusite is a constituent of quartzite at Grass Valley, Lindgren[6].

Riverside County: Large crystals of pink andalusite are found near Coahuila, Kunz[7], Schaller[4].

200. SILLIMANITE—Fibrolite.

Silicate of aluminium, Al_2SiO_5.

Orthorhombic. Long slender prisms and fibers. Cleavage perfect brachypinacoidal. Color grayish and light brown. Vitreous luster. H=6—7; G=3.23.

Refractive indices: $\alpha=1.638$; $\beta=1.642$; $\gamma=1.653$.

Reactions are identical to those for andalusite and the two minerals are generally differentiated by dissimilar structure.

A constituent of metamorphic gneiss and schist, and usually with cyanite, andalusite and staurolite.

Inyo County: Random fibers of sillimanite in schist are found at the scheelite deposit in Deep Canyon, west of Bishop. Massive, near Laws.

Mariposa County: Occurs in the schists near Mariposa, Turner[4], Fairbanks[1].

San Bernardino County: Occurs in schist fifteen miles southeast of Daggett, at Ord Mountain.

San Diego County: A constituent of the dumortierite gneiss at Dehesa, Schaller[5].

201. CYANITE—Disthene.

Silicate of aluminium, Al_2SiO_5.

Triclinic. Long slender or blade-like crystals. Cleavage perfect macropinacoidal. Color sky-blue, green, white. Vitreous to pearly luster. H=5—7; G=3.56—3.67.

Refractive indices: $\alpha=1.712$; $\beta=1.720$; $\gamma=1.728$.

Infusible and insoluble. Like andalusite in its behavior before the blowpipe. Can be distinguished from andalusite and sillimanite by physical properties.

A common metamorphic mineral found in schists and gneisses with andalusite, sillimanite and dumortierite.

Imperial County: Large blue boulders of dumortierite rock found in the Cargo Muchacho district near Ogilby contain small crystals of cyanite.

Los Angeles County: Found in the schists near Los Angeles.

Tuolumne County: A constituent of the schists on Yankee Hill.

202. SPURRITE.

Carbonato-silicate of calcium, $2Ca_2SiO_4.CaCO_3$.

Monoclinic. Granular masses. One good cleavage. Pale gray to slightly bluish. H=5.

Refractive indices: $\alpha=1.640$; $\beta=1.672$; $\gamma=1.676$.

Infusible. Gives calcium flame. Soluble with some effervescence and separation of silica.

A mineral formed by contact metamorphism in limestone, but very rare.

Riverside County: Occurs intimately associated with merwinite and gehlenite in the limestone at Crestmore. Foshag[2].

203. DATOLITE.

Basic silicate of boron and calcium, $HCaBSiO_5$.

Monoclinic. Small crystals and massive. Colorless to white, often with greenish tinge. Vitreous luster. H=5—5.5; G=2.9—3.0.

Refractive indices: $\alpha=1.625$; $\beta=1.653$; $\gamma=1.669$.

Fuses easily to a clear glass and colors flame green. Easily soluble in hydrochloric acid and solution boiled down to almost dryness yields gelatinous silica. Gives a little water in closed tube.

Datolite forms veins of glassy crystals or white massive material in dikes and along the contact of igneous intrusions of diabase and diorite.

Inyo County: White massive datolite was associated with vesuvianite and garnet at the San Carlos mine and was analysed by J. L. Smith[1].

SiO_2	B_2O_3	CaO	H_2O		
38.02	21.62	33.87	5.61	=99.12%	G=2.988

Riverside County: Massive white glassy datolite, with slight greenish tinge, occurs with the pegmatite at Crestmore.

San Francisco County: Glassy crystals and white veins of datolite occur in an old altered diabase dike in the serpentine at Fort Point. Analysed by Schaller. Forms: (001), (100), (110), (120), (011), (012), (102), (104), ($\bar{1}02$), (111), $\bar{1}11$), ($\bar{1}12$), ($\bar{1}13$), ($\bar{1}14$), ($\bar{1}16$), (312), (121), ($\bar{2}31$), (1.1.18), Eakle[1].

SiO_2	Al_2O_3	B_2O_3	CaO	H_2O	
36.71	0.17	22.11	33.83	6.52	=99.34%

204. ZOISITE.

Basic silicate of calcium and aluminium, $HCa_2Al_3Si_3O_{13}$.

Orthorhombic. Prismatic crystals; sometimes massive. Cleavage perfect brachypinacoidal. Color grayish white to greenish gray. Vitreous luster. H=6—6.5; G=3.25—3.37.

Refractive indices: $\alpha=1.700$; $\beta=1.702$; $\gamma=1.706$.

Insoluble, but fuses rather easily with some intumescence to a light-colored slaggy mass, which, if pulverized and boiled in hydrochloric acid, will yield gelatinous silica. A small amount of moisture can be obtained in a closed tube by intense heating.

Zoisite belongs to the metamorphic class of minerals and is often developed by the metamorphism of gabbros and diorites. It is not an uncommon mineral in the State, but has seldom been mentioned.

Saussurite is a mixture of zoisite, calcite and plagioclase feldspar formed in gabbros and plutonic rocks by alteration and pressure, and the process of change is called "saussuritization."

Clinozoisite. Name given to a rock-forming silicate near zoisite in composition but monoclinic in crystallization.

Refractive indices: $\alpha = 1.714$; $\beta = 1.715$; $\gamma = 1.719$.

Lake County: Zoisite is mentioned by Becker[1] as common in the metamorphic rocks at Sulphur Bank and in the Coast Range. Analysed from Sulphur Bank.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	NiO	MnO	CaO	MgO	Na_2O
39.80	tr.	22.72	4.85	1.49	--	0.26	17.55	3.89	4.09
39.19	1.17	22.76	6.49	1.78	tr.	0.09	22.02	1.64	3.38

K_2O	H_2O	P_2O_3	
0.12	5.25	--	=100.02%
0.58	1.12	tr.	=100.22

Plumas County: Found in the Diadem Lode, Meadow Valley, Turner[4].

Riverside County: Saussurite is common in the igneous rocks of Eagle Mountains.

Santa Clara County: Mentioned by Murgoci[1] in the eclogite of Oak Ridge. Clinozoisite also occurs as a constituent of the eclogites of the Calaveras Valley.

Shasta County: Saussurite was analysed by Clarke[1] from a gabbro found thirty-seven miles north of Pit River Ferry.

SiO_2	Al_2O_3	FeO	CaO	MgO	Na_2O	H_2O	
42.79	29.43	3.65	18.13	1.40	2.51	2.42	=100.33%

Sonoma County: Found in quartzite at Pine Flat, Murgoci[1]. Occurs also near Healdsburg.

205. EPIDOTE.

Basic silicate of calcium, aluminium and iron, $HCa_2(Al,Fe)_3Si_3O_{13}$.

Monoclinic. Crystals, massive, earthy. Cleavage perfect basal. Color pistachio-green, dark green, dark brown, yellow. Vitreous luster. H=6 — 7; G=3.25 — 3.5.

Refractive indices: $\alpha = 1.729$; $\beta = 1.754$; $\gamma = 1.768$.

Similar to zoisite in its reactions, but fuses to a black slag.

Epidote is a very common mineral in the State, especially as an alteration mineral in crystalline rocks. It is often found in aggregates of large crystals and columnar masses in veins with quartz and feldspar.

Alpine County: Occurs in the hills near Loop.

Butte County: Mentioned by Silliman[7] as a constituent of the gold washings at Cherokee.

Calaveras County: Large crystals found at Bald Point on the Mokelumne River, at Mokelumne Hill, and at Copperopolis. Found with quartz, seven miles north of Angels.

Colusa County: Green epidote is associated with hematite in a deposit four miles south of Lodoga. Yellow ocher outcrops on Stony Creek, 4½ miles west of Stonyford.

Contra Costa County: In the rocks on Mount Diablo and in the Diablo Range.

El Dorado County: Fine large crystals occurred in a coarse vein with orthoclase, bornite and molybdenite which were coated with axinite, at the old Cosumnes copper mine. Minute prisms in quartz at Placerville.

Fresno County: Common at Grub Gulch. As contact mineral with quartz and garnet near Trimmer; found near Sanger.

Humboldt County: Large prisms with calcite in schists on west side of Horse Mountain. Common as a rock-forming mineral near Orleans.

Inyo County: Columnar specimens have come from near Independence.

Kern County: Associated with scheelite at the Cadillac claims, Greenhorn mining district.

Lassen County: Occurs with native copper at the Lummis mine.

Los Angeles County: Found with bitumen and orthoclase at White Point and with labradorite near San Pedro. Disseminated through crystalline limestone in Pacoima Canyon, 3½ miles from San Fernando.

Madera County: Common on the Minaret Mountains. Associated with quartz, hematite and magnetite in the Hildreth mining district. Specimens have come from Coarse Gold.

Marin County: Occurs with lawsonite at Reed Station, Ransome[2].

Mariposa County: Massive at Hornitos. Also near Coulterville and at Yosemite Cliff. On the south side of Mount Hoffman.

Mono County: Massive at Epidote Peak at head of East Fork of Green Creek. Occurs in rock near Mono Lake.

Nevada County: Common near Glen Alpine with violet axinite. At Meadow Lake, Lindgren[4][5], and also at Grass Valley. With quartz and calcite at the Oustamoh mine.

Placer County: Near Newcastle.

Plumas County: With garnet and quartz on Mount Herbert. Occurs with garnet at contact of limestone and granodiorite at the Cosmopolitan and Duncan mines, Genessee district. Occurs at Engels with bornite and chalcopyrite.

Riverside County: Deep green epidote occurs in the calcite and long prismatic crystals, altered brown, occur in the pegmatite at Crestmore.

Associated with specular hematite in the Monte Negro mining district. Occurs ten miles from Beaumont. In gneiss on Eagle Mountains.

San Bernardino County: Common in the Monte Negro district, Storms[1]. Coarsely crystalline with calcite at contact of granodiorite and limestone in the Morongo district. Occurs with specular hematite seventeen miles northwest of Needles. Associated with garnet, magnetite and hematite in the iron ore deposit near Dale.

San Diego County: Occurs as a secondary mineral with black tourmaline at Rincon, Rogers[3]. Clear, transparent crystals of gem quality occur at the McFall mine, 7½ miles southeast of Ramona. Occurs near Campo.

San Luis Obispo County: Occurs with quartz, pyrite and calcite near La Panza.

Santa Clara County: In the eclogite of Calaveras Valley, Murgoci[1].

Shasta County: Epidote from this county was analysed by Schaller.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
38.22	25.12	8.75	1.25	0.19	tr.	22.77	0.11	0.06

H_2O at 105°	H_2O ab. 105°	TiO_2
0.52	3.04	0.33=100.36%

Siskiyou County: Associated with dark brown garnet and quartz on South Fork of Coffee Creek. Occurs in a schist near Seiad.

Sonoma County: In glaucophane schist near Healdsburg.

Trinity County: Green epidote associated with colorless garnet, titanite and zircon, occurs in a soda granite-porphyry in the Iron Mountain district, Weaverville Quadrangle. With calcite at Douglas City. As a contact mineral in limestone with garnet at Red Mountain.

Tulare County: Common in the Mineral King district, Goodyear[1]. Large divergent columns at Eber Flat and at Three Rivers. Also common in Fraser Valley. Occurs with quartz and garnet on Crowley Mountain near Dunn Valley. Specimens have come from near Lindsay. Large masses of divergent prismatic crystals occur at Eber Flat.

Tuolumne County: Near Sonora.

Yuba County: At Smartsville.

206. ALLANITE—Orthite.

Basic silicate of calcium, iron, aluminium and cerium.

Monoclinic. Flat tabular crystals and imbedded grains. Color brownish black. Pitchy luster. H=5.5—6; G=3.5—4.2.

Refractive index: β=1.74.

Soluble in hydrochloric acid, yielding gelatinous silica. Fuses easily with intumescence to a dark slag. The rare earth bases can only be determined chemically.

A constituent of some crystalline rocks, but some of its reported occurrences in the State are doubtful.

Riverside County: Has been observed as a constituent of the gneiss of Eagle Mountains.

Santa Barbara County: Said to have been found in rock near Santa Barbara.

Tulare County: Specimens of pegmatite rock containing massive allanite occur near Exeter on the Gasenberger Ranch associated with rose quartz.

207. PIEDMONTITE.

Basic silicate of calcium, aluminium, manganese and iron, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.

Monoclinic. Prismatic crystals. Color reddish brown and reddish black. Reddish streak. Vitreous luster. H=6.5; G=3.4.

Refractive index: β=1.83.

Insoluble in acid. Fuses easily with intumescence to a black glass. Gives a violet bead of manganese with borax.

San Bernardino County: A specimen of the manganese epidote has come from this county.

San Diego County: Found in the thin section of a dark red quartz-porphyry boulder from the gravels at Pacific Beach, Rogers[5].

208. AXINITE.

Borosilicate of alumnium and calcium with iron and manganese, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.

Triclinic. Thin wedge-shaped crystals. Sometimes granular massive. Color clove-brown, yellow. Vitreous luster. H=6.5—7; G=3.27.

Refractive indices: α=1.678; β=1.685; γ=1.688.

Insoluble. Fuses with swelling and intumescence and may show slight greenish flame. Powder mixed with potassium bisulphate and fluorite and held on platinum wire in the Bunsen flame, will give a momentary green flame of boron.

Crystals of axinite are sometimes developed in the veins and along the contact of intrusive rocks but the mineral is rather rare in its occurrence.

El Dorado County: Small clove-brown crystals occurred deposited on epidote at the old Cosumnes copper mine near Fairplay. They have been described and analysed by Schaller[11]. Forms: $(1\bar{1}0)$, (010), $(1\bar{2}0)$, $(1\bar{3}0)$, $(1\bar{6}0)$, (1.29.0), (160), (270), (7.11.0), (110), (540), (430), (210), (310), (510), (100), $(3\bar{1}0)$, $(9\bar{5}0)$.

SiO_2	Al_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O	
42.79	16.38	4.22	19.21	8.76	0.09	6.70	1.85	=100.00%

Inyo County: Found in the Funeral Mountains and in the Owl Mountains, Death Valley. Perfectly formed small white crystals with smithsonite occur at the Ubehebe mine. Crystals found in the Argus Range.

Nevada County: Thin bladed masses of violet-colored axinite occur in veins near Glen Alpine.

Riverside County: A large axinite crystal from the city quarry at Riverside, measured 9 by 12 by 1½ centimeters. The forms are: $(1\bar{1}1)$, (111), $(1\bar{1}0)$, (201), (001), (110), and $(0\bar{1}0)$. The axinite of this quarry is violet brown, Rogers[5]. Violet axinite occurs associated with cinnamon garnet in the pegmatite at Crestmore. Crystals of violet colored axinite are found in the Box Springs Mountains.

San Diego County: Smoky-pink crystals occur in an altered granite in Moosa Canyon, about eighteen miles south of Pala near Bonsall, associated with quartz, epidote and laumontite, and have been described by Schaller[11]. Forms: $(1\bar{1}0)$, $(1\bar{3}0)$, (110), (100), $(3\bar{3}1)$, $(1\bar{1}1)$, $(1\bar{1}2)$, (021), $(\bar{1}32)$, (201), (111), $(1\bar{3}1)$, $(1\bar{3}2)$.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MnO	MgO	B_2O_3	H_2O	
42.61	17.43	0.38	7.53	19.74	4.10	0.44	6.04	1.56	=99.83%

209. PREHNITE.

Acid silicate of calcium and aluminum, $H_2Ca_2Al_2Si_3O_{12}$.

Orthorhombic. Tabular crystals, granular, drusy masses. Color light green to white. Vitreous luster. H=6—6.5; G=2.8—2.95.

Refractive indices: $\alpha=1.616$; $\beta=1.626$; $\gamma=1.649$.

Slightly soluble. Fuses with intumescence to an enamel. Gives water in closed tube. The fused mass will gelatinize with hydrochloric acid.

Green drusy coatings and veins of prehnite are sometimes present in altered diabase and lavas, but the mineral is not common in the State.

Lotrite is a mineral similar to prehnite in composition, but differs from it in optical characters.

Plumas County: Occurs as a hydrothermal product at the Engels mine.

Riverside County: Green drusy and light brown prehnite occur in cavities of white feldspar in the pegmatite veins of the limestone at Crestmore. Forms of brown crystals are: (001), (110), (100), and (061). Analysis of the brown variety:

SiO_2	Al_2O_3	CaO	H_2O	
44.10	24.20	25.20	5.86	=99.36%

Santa Barbara County: Prehnite occurred in the analcite-diabase of Cuyamas Valley, Fairbanks[3].

Santa Clara County: Lotrite was observed by Murgoci[1] as probably present in the greenstone of Calaveras Valley.

210. CHONDRODITE.

Fluosilicate of magnesium, $[Mg(F,OH)]_2Mg_2[SiO_4]_2$.

Monoclinic. Usually in grains. Color yellow to brown. Vitreous luster. H=6—6.5; G=3.1—3.2.

Refractive indices: $\alpha=1.607$; $\beta=1.619$; $\gamma=1.639$.

Infusible. Soluble with gelatinization. Fused with potassium bisulphate in a closed tube, gives off fluorine, which will etch the glass. Magnesia is precipitated from ammonia solution by sodium phosphate.

A fairly common mineral formed in the metamorphism of a dolomitic limestone.

Riverside County: Some of the crystalline limestone at Crestmore shows evidence of the former presence of granular chondroite. Reported to occur in the limestone at Colton. Observed in the City Quarry at Riverside, and mentioned by Rogers. Occurs in the limestone of the Jensen property about three miles west of Crestmore.

211. ILVAITE.

Silicate of iron and calcium, $CaFe_2(FeOH)(SiO_4)_2$.

Orthorhombic. Long prisms vertically striated. Color grayish black. Submetallic luster. H=5.5—6; G=4.0.

Refractive index: $\beta=1.91$.

Becomes magnetic after heating. Easily fusible. Soluble in hydrochloric acid and yields much gelatinous residue.

Ilvaite is a rare mineral and is only known from two localities in the State. Formed by contact metamorphism in crystalline limestone.

Shasta County: Thin bands and long prisms of ilvaite occur on both sides of a narrow dike cutting through limestone on Potter Creek, near Baird. The crystals occur on quartz and hedenbergite and have been described by Prescott[1]. Forms: (110), (120), (010), (111), (101), (890). Analysed by H. R. Moss.

SiO_2	Fe_2O_3	Al_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	H_2O	
28.09	20.80	0.32	0.13	29.93	3.24	15.89	0.18	1.62	=100.20%

Sonoma County: A boulder of quartzite colored black with ilvaite was found near Petaluma.

212. CALAMINE.

Basic silicate of zinc, $H_2Zn_2SiO_5$.

Orthorhombic. Hemimorphic crystals, drusy masses, earthy. Cleavage perfect prismatic. Color white; sometimes bluish or brown. H=4.5—5; G=3.4—3.5.

Refractive indices: $\alpha=1.614$; $\beta=1.617$; $\gamma=1.636$.

Soluble with gelatinization. Difficultly fusible. Mixed with sodium carbonate and reduced on charcoal, gives yellow coating of zinc. Some water in a closed tube.

Calamine is found in the oxidized portion of veins carrying zinc, but its occurrence in California is quite limited.

Inyo County: Small amounts have been found with willemite and smithsonite at the St. Ygnacio, Cerro Gordo and Indiana mines, and in Surprise Canyon.

San Bernardino County: Found with smithsonite at the Cuticura mine, near Daggett.

213. LAWSONITE.

Basic silicate of calcium and aluminium, $H_4CaAl_2Si_2O_{10}$.

Orthorhombic. Prismatic and tabular crystals. Cleavage perfect basal and brachypinacoidal. Color pale blue to white. Vitreous luster. H=8; G=3.09.

Refractive indices: $\alpha=1.665$; $\beta=1.674$; $\gamma=1.684$.

Swells and fuses to a frothy mass. Very slightly acted on by hydrochloric acid. Yields water in a closed tube.

Lawsonite was discovered in California as a new constituent of certain schists, and since its discovery has been found to be quite widespread in its occurrence in the rocks of the Coast Range. It is limited to the metamorphic rocks.

Contra Costa County: Found as a constituent of a chlorite boulder on side of hill north of Berkeley and analysed by Eakle[6].

SiO_2	$Al_2O_3Fe_2O_3$	CaO	H_2O	
38.43	33.39	16.85	9.83	=98.50%

Marin County: Discovered as a new mineral in the schists of the Tiburon Peninsular, near Reed Station, and was described and named by Ransome[2]. Forms: (011), (110), (041), (001). Additional forms by Hillebrand and Schaller[1], (221), (331).

Analyses: 1. Ransome and Palache; 2. Hillebrand and Schaller.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	Ign.	
1.	38.10	--	28.88	0.85	--	--	18.26	0.23	--	0.65	11.42	= 99.39%
	37.32	--	35.14		--	--	17.83	--	--	--	11.21	=101.50
2.	38.45	0.38	31.35	0.86	0.10	tr.	17.52	0.17	0.23	0.06	11.21	=100.33

San Luis Obispo County: Masses of green chlorite with platy crystals of lawsonite occur about four miles east of San Luis Obispo.

Santa Clara County: Mentioned by Murgoci[1] and by J. P. Smith[1] as one of the constituents of the gneisses, schists and quartzites of Oak Ridge, Redwood and Calaveras Valley.

214. TOURMALINE.

Borosilicate of aluminium with various bases.

Hexagonal, rhombohedral. Long prismatic crystals, often divergent radiating groups. Color black, green, rose-red, brown, blue, smoky. Vitreous luster. H = 7 — 7.5; G = 2.98 — 3.2.

Refractive indices: $\epsilon = 1.641$; $\omega = 1.687$.

Generally fusible to a blebby mass. Insoluble in acids. Fused on platinum wire with a mixture of potassium bisulphate and fluorite, will give a momentary green flame.

The green flame distinguishes the black tourmaline from black hornblende when the physical characters are similar, and the brown tourmaline is likewise distinguished from brown garnet.

Black tourmaline is a very common mineral in the State and large areas of tourmaline-granites exist in the Sierras. Brown tourmaline has also been found, but in limited quantity. The richly colored red and green tourmalines of San Diego County are the finest in the world, and have become almost universally known and used as gems. Tourmaline always occurs in prismatic crystals, often bunched into radiating groups and usually much fractured. The common black tourmaline is characteristic of granites and quartz veins in granites. Brown tourmaline is found in crystalline limestone near the contact with intrusive igneous rock. The transparent green and red and other shades occur in pegmatite veins which carry lithia and they are classed as lithia-tourmalines. The red tourmaline is often called *rubellite,* the blue, *indicolite* and the colorless, *achroite.*

Alpine County: Black tourmaline is common in Hope Valley.

Calaveras County: Black occurs in quartz at Sheep Ranch.

El Dorado County: Black tourmaline occurs with orthoclase at Buck's Bar. Small, black crystals occur in orthoclase quartz rock, twenty miles east of Placerville.

Fresno County: Black is common in Fine Gold Gulch, at the Enterprise mine, and at Eber Flat. Black crystals associated with hornblende and quartz occur in Watts Valley. Black occurs in the Sycamore district. Red and green tourmaline occurs in quartz on the White Divide, south of Mt. Godard. Green occurs on Spanish Peak associated with brown garnet, Bradley[1].

Inyo County: Black occurs in the Lee district. Black crystals occur in a metamorphosed sandstone at Deep Canyon, west of Bishop. Needles and reticulated masses of black, slender prisms are found in the Slate Range.

Kern County: Black is found in the rocks of the Tehachapi Mountains. Black tourmaline occurs in a calcite vein cutting schist, associ-

ated with scheelite a few miles west of Randsburg. A large vein of quartz and feldspar containing black tourmaline occurs near Woody.

Lassen County: Specimens of black tourmaline have come from near Susanville.

Madera County: Black tourmaline occurs in the rocks near Raymond.

Mariposa County: Black is very common in the granites of the Yosemite Valley.

Modoc County: Black crystals occur in quartz near Cedarville.

Mono County: Radiating masses of black tourmaline occur near a contact mass of magnetite, which carries greenockite, near Topaz.

Nevada County: Black occurs at Emerald Bay, Lake Tahoe and near Crystal Peak. A dark brown variety found two miles northwest of Colfax was analysed by Melville[2].

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	B_2O_3	Ign.
36.40	33.64	3.13	1.51	10.01	0.12	2.49	6.52	3.53

F 0.74 O=F =98.07 — 0.31=97.76%

Orange County: Black is found at the Santa Ana tin mine, Santa Ana Mountains.

Placer County: Black at Soda Springs. Black tourmaline in quartz is found near Blue Canyon. Specimens of black with quartz occur at the Excelsior mine, near Cisco. Occurs in granitic rock as black tourmaline with white feldspar and glassy quartz, near Rocklin.

Plumas County: Black tourmaline occurs at Red Clover Creek.. Black tourmaline in quartz occurs on Grizzly Range, and near Taylorsville. Occurs in the pegmatites at Engels. Black crystals occur seven miles from Portola.

Riverside County: Some fine gem tourmaline occurs near Coahuila and in the San Jacinto Mountains. Black tourmaline in quartz occurs in the Santa Maria Mountains, two miles north of Blythe. Black tourmaline occurs occasionally in the pegmatite veins at Crestmore. Black radiating prisms occur with axinite on Box Spring Mountain. Occurs in a pegmatite vein in the Pinacate district.

San Bernardino County: Black at Halleck.

San Diego County: A series of pegmatite veins consisting mainly of white albite with quartz and lepidolite mica, cut through the diorite hills in the northwestern part of the county from the vicinity of Mesa Grande northward through Pala and into Riverside County, and these veins have been prolific in their yield of beautiful transparent tourmalines in many shades of rose-red and green. The first mention of the occurrence of rubellite and lepidolite in southern California was by W. P. Blake[15], who gave the locality as the San Bernardino Range.

Later Orcutt[1] described the occurrence at Pala. The first material obtained was the lavender and lilac lepidolite containing radiating clusters of bright red rubellite prisms, which form beautiful museum specimens and can be seen in most mineral collections. The gem varieties were found later and since 1893 a number of mines have been located and many large beautiful crystals obtained. At present the best tourmalines come from Mesa Grande. Sterrett[1] gives the crystallography of tourmaline from Damoron ranch, four miles northwest of Mesa Grande. Forms: $(02\bar{2}1)$, $(12\bar{3}0)$, $(14\bar{5}0)$, $(21\bar{3}1)$, $(12\bar{3}2)$, $(000\bar{1})$, $(01\bar{1}\bar{1})$, $(10\bar{1}2)$, $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(10\bar{1}1)$, and (0001). Tourmalines of many shades, black, pink, blue, violet, green and colorless, occur at Rincon in the Victor and other claims and some of the crystals have the forms: $(11\bar{2}0)$, $(10\bar{1}0)$, $(01\bar{1}0)$, $(12\bar{3}2)$, $(10\bar{1}1)$, $(000\bar{1})$, $(01\bar{1}\bar{1})$, Rogers[3]. Analyses of the tourmaline of the county have been made by Schaller[7]. 1. Pink from Mesa Grande; 2. Pale green from Mesa Grande; 3. Pink from Pala; 4. Altered pink from Pala; 5. Black from Lost Valley; 6. Black from Ramona.

SiO_2	37.57	36.72	36.98	37.05	35.96	35.21
Al_2O_3	42.18	41.27	43.69	44.25	33.28	36.07
TiO_2	tr.	0.06	--	--	0.36	0.23
FeO	0.19	1.13	--	--	11.04	11.11
MnO	0.24	1.48	tr.	tr.	0.13	0.98
MgO	none	none	tr.	0.10	3.48	0.19
CaO	1.20	0.87	0.25	0.22	0.42	0.25
Li_2O	1.92	1.76	1.28	1.27	none	tr.
Na_2O	2.05	2.23	2.02	1.06	2.16	1.92
K_2O	none	none	2.29	1.95	none	none
B_2O_3	10.65	10.60	7.66	2.46	10.61	10.48
H_2O	3.39	3.33	4.67	10.81	3.31	3.51
F	0.29	0.31	--	--	none	--
	99.77	99.76	98.84	99.17	100.75	99.95%

The bluish green tourmaline from the Mountain Lily mine near Oak Grove has been called "emeralite." Fine blue and pink occurs at the Peter Cabat mine, about six miles north of Warner's Hot Springs. A deposit of green tourmaline occurs south of Banner. Good blue and green occur on east side of Chihuahua Valley. Black tourmaline occurs with cassiterite on Aguanga Mountain.

San Luis Obispo County: Black tourmaline occurs in the rocks of the Santa Margarita Hills.

Siskiyou County: Black crystals in quartz occur near Etna Mills. Black, slender crystals in quartz associated with specular hematite occur at Westwood.

Trinity County: Small rosettes of black tourmaline occur at the Mountain Monarch Prospect, Weaverville Quadrangle.

Tulare County: Black in Frazer Valley, Drum Valley, and at Mineral King. Black crystals with feldspar and muscovite occur near Milo. Black occurs in quartz near Dinuba.

Tuolumne County: Black near Crimea House, near Sonora and near Soulsby. Occurs with quartz as black prisms about eight miles south of Sonora.

215. DUMORTIERITE.

Basic silicate of aluminium with boron. $HAl_6BSi_3O_{20}$.

Orthorhombic. Small prisms, granular. Color smalt-blue, dark blue, violet-red. Vitreous luster. H = 7; G = 3.22 — 3.43.

Refractive indices: $\alpha = 1.678$; $\beta = 1.686$; $\gamma = 1.689$.

Insoluble and infusible. Fused on platinum wire with a mixture of potassium bisulphate and fluorite will give a momentary green flame.

Dumortierite is a metamorphic mineral found in certain gneisses and schists; very rare in its occurrence.

Imperial County: Dark blue boulders of dumortierite occur on the plains about twenty-five miles from Ogilby.

Riverside County: Massive dark blue dumortierite occurs one mile north of Big Four mines, Pinacate district.

San Diego County: A violet-red variety of dumortierite occurs near Dehesa and was described and analysed by Schaller[5] and also analysed by Ford[1]. Forms: (010), (100), (110), (120), (320), (210), (102), (203).

	SiO_2	Al_2O_3	Ti_2O_3	Fe_2O_3	B_2O_3	H_2O	
Schaller	28.68	63.31	1.45	0.23	5.37	1.52	=100.56%
Ford	30.58	61.83	--	0.36	5.93	2.14	=100.84

Tuolumne County: Boulders of dark blue dumortierite have been found in the county.

CHAPTER IX.

HYDROUS SILICATES AND TITANO-SILICATES.

Micas.
- Muscovite
- Mariposite
- Paragonite
- Lepidolite
- Phlogopite
- Biotite
- Lepidomelane
- Roscoelite

Brittle Micas.
- Margarite
- Xanthophyllite
- Chloritoid
- Ottrelite

Chlorites.
- Clinochlore
  - Kotchubeite
- Penninite
  - Kämmererite
- Prochlorite
- Corundophyllite
- Griffithite
- Chalcodite
- Jefferisite

Zeolites.
- Heulandite
- Phillipsite
- Laumontite
- Stilbite
- Chabazite
- Analcite
- Natrolite
- Mesolite
- Thomsonite

Not Grouped.
- Gyrolite
- Jurupaite
- Apophyllite
- Xonotlite
  - Eakleite
- Okenite
- Inesite
- Ganophyllite
- Crestmoreite
- Riversideite
- Plazolite
- Serpentine
- Chrysotile
- Deweylite
- Garnierite
- Talc
- Sepiolite
- Celadonite
- Pyrophyllite
- Kaolinite
- Halloysite
- Montmorillonite
- Allophane
- Rectorite
- Cimolite
- Thaumasite
- Chrysocolla
- Chloropal
  - Nontronite
- Bementite
- Neotocite
- Pilolite
- Searlesite

Titano-silicates.
- Titanite
- Benitoite
- Neptunite

MICAS.

The mica family consists of a number of silicates, having various and complex compositions, which occur characteristically in thin elastic scales and plates. The common micas, muscovite and biotite, are very important rock-forming minerals of igneous and metamorphic rocks, and are to be found all over the State. There are several rare micas and alteration products of micas which have not been observed in California and will therefore not be mentioned.

216. MUSCOVITE—Potash Mica.

Hydrous silicate of potassium and aluminium, essentially $(H,K)AlSiO_4$.

Monoclinic. Hexagonal-shaped plates, plumose aggregates, scales. Cleavage perfect basal. Colorless, gray, brown, pale green. Vitreous luster. H = 2 — 2.5; G = 2.76 — 3.

Refractive indices: $\alpha = 1.561$; $\beta = 1.590$; $\gamma = 1.594$.

Insoluble in acids and very difficult to fuse. A little of the powder taken on a platinum wire and moistened with sulphuric acid will give the violet flame of potassium when held in the colorless Bunsen flame. A small amount of moisture is obtained by intense heating in a closed tube.

Muscovite is a common constituent of granites, syenites, gneisses and schists. It is generally called mica or isinglass and is of economic

value when in large transparent sheets. Extensive areas of mica-schists occur in the State in which muscovite is the principal constituent and gives the rock its schistose structure.

Sericite is a soft greasy-feeling muscovite forming mostly sericitic schists.

Fuchsite is a chrome-muscovite of an emerald-green color.

Pinite and Agalmatolite are names given to compact muscovite or altered muscovite, usually of gray or white color.

Alexandrolite is a name given to a pale green micaceous mineral belonging to the chrome micas.

El Dorado County: According to Hanks[6] some material resembling agalmatolite occurred in a vein at Greenwood.

Inyo County: Muscovite is found in the Saratoga district.

Lassen County: Muscovite was early reported from Susanville.

Nevada County: Sericite and biotite are mentioned by Lindgren[6] as constituents of the rocks of Grass Valley and Nevada City.

Orange County: Fuchsite has been found at Arch Beach.

Plumas County: Sericite occurs as a hydro-thermal mica at Engels.

Riverside County: Muscovite and lepidolite occur with the gem tourmaline at Coahuila.

San Diego County: Muscovite is a common mineral in the pegmatite veins which carry the gem tourmaline and kunzite of this county. Crystals occur at the Mack mine, Rincon, with the forms: (001), (010), (221), Rogers[2].

Pink muscovite from Mesa Grande has been analysed by Schaller[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O
45.63	tr.	37.42	tr.	0.06	none	none	0.20	1.43	9.95
				H_2O	F		O=F		
				4.43	0.77		=99.89 — 0.32=99.57%		

Tulare County: A green micaceous and earthy mineral containing chromium and believed to be alexandrolite occurs near Exeter. No analysis of the mineral has been made.

Ventura County: Good sheets of muscovite have come from the Mount Almo mica mine.

217. MARIPOSITE.

Monoclinic. Micaceous, scales, foliated massive. Cleavage perfect basal.

Color apple-green, white. Vitreous luster. H=2.5 — 3; G=2.78 — 2.81.

Refractive indices: α =1.60; β=1.63; γ=1.63.

Similar to muscovite in its reactions. An emerald green borax bead is sometimes obtained.

Mariposite is essentially a muscovite with its characteristic green color due to the presence of chromic oxide. It is distinctly characteristic of the gold belt of the Sierras and was described as a new mineral by Silliman[6].

Calaveras County: Occurs in schist on Carson Hill at the Reserve mine and at the Golden Gate mine.

El Dorado County: Green flakes of mariposite occur in quartz at the Pyramid mine, four miles north of Shingle Springs.

Kern County: Some green micaceous mariposite occurs at Randsburg.

Mariposa County: The green mica, mariposite, is common in the Mother Lode schists of this county and of Tuolumne and Calaveras counties, and it was first described by Silliman[6] as a new mineral. The mineral from the Josephine mine was analysed by Hillebrand, Turner[4].

	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	CaO	MgO
Green	55.35	0.18	25.62	0.18	0.63	0.92	0.07	3.25
White	56.79	25.29		none		1.59	0.07	3.29

K_2O	$(Li,Na)_2O$	H_2O	
9.29	0.12	4.52	=100.13%
8.92	0.17	4.72	=100.84

Nevada County: Good specimens of green mariposite occur with quartz and calcite in veins at the Red Ledge mine, Washington. Occurs at the Idaho mine, Grass Valley.

Placer County: Found at the Marguerite mine.

San Diego County: Found also near Oak Grove and on west side of Mt. San Jacinto.

Sierra County: Mariposite is found at the Rainbow mine. Occurs at the Alhambra mine, Poker Flat, and at the El Dorado mine, Forest mining district.

Tuolumne County: Mariposite is common at the Rawhide Ranch mine near Tuttletown. Also at the App mine, Omega mine and other mines in the vicinity of Jamestown.

218. PARAGONITE—Soda Mica.

Silicate of sodium and aluminium, $H_2NaAl_3Si_2O_{12}$.

Massive, compact, scaly. Cleavage perfect basal. Color gray, yellowish gray, pale green. Pearly luster. H=2.5—3; G=2.78—2.90.

Refractive index: β=1.60.

Like muscovite in its reactions, but gives the yellow sodium flame.

The rocks of the Coast Ranges are notably rich in soda and this mica has been observed as one of the constituents of the schists.

Santa Clara County: Paragonite is mentioned as a constituent of eclogite at Coyote Creek, near San Martin and of greenstone on San Franeisquito Creek. J. P. Smith[1].

219. LEPIDOLITE—Lithia Mica.

Silicate of lithium, potassium, fluorine and aluminium $(KLi)Al(OH,F)\ Al(SiO_3)_3$.

Monoclinic. Commonly in scaly masses; sometimes in broad plates. Cleavage perfect basal. Color lilac, lavender, violet-blue, pink to colorless. Vitreous to pearly luster. H = 2.5 — 4; G = 2.8 — 2.9.

Refractive indices: $\alpha = 1.560$; $\beta = 1.598$; $\gamma = 1.605$.

Easily fusible to a white globule, and shows the red flame of lithium. Insoluble in acids. A small amount of water is obtained in a closed tube by intense ignition, which reacts acid.

Lepidolite occurs in scaly masses of a lavender, violet and pink color. It is the characteristic mica of pegmatitic veins which carry red and green tourmaline.

Cookeite is a hydrous lithia mica, white to yellowish green in color.

Inyo County: Pink lepidolite with muscovite occurs in the vein matter of Half Dollar mine.

San Bernardino County: Cookeite has been reported from Oro Grande.

San Diego County: Lepidolite mica ranging in color from gray through lavender and rose to deep violet is the common mica associated with the gem tourmaline of the county. Good crystals were found four miles east of Ramona having the forms: (001), (010), (100), (023), (112), ($\bar{1}$11), (132), (130), ($\bar{2}$23), ($\bar{2}$21)?, (11$\bar{2}$)?, Schaller[6]. Coarse and fine scaly lepidolite is common at the Victor mine, Rincon, and crystals have the forms (001), (100), (010), ($\bar{1}$31), Rogers[2]. The lepidolite of Pala and of Mesa Grande has been analysed by Schaller[7]. 1. Red purple from Pala, Tourmaline Queen mine; 2. Blue purple from Pala; 3. Purple; 4. White; 5. Lepidolite border on muscovite from Mesa Grande.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	Mn_2O_3	MnO	MgO	CaO	Li_2O	Na_2O
1.	51.12	22.20	0.80	--	1.34	--	--	--	5.12	2.28
2.	50.95	23.97	0.82	--	1.29	--	--	--	4.63	2.39
3.	50.34	28.71	0.11	tr.	--	0.50	none	tr.	2.39	1.59
4.	51.25	25.62	0.12	none	--	0.05	none	tr.	4.31	1.91
5.	50.85	26.78	0.60	--	--	0.07	tr.	0.10	4.27	1.41

	K_2O	H_2O	P_2O_5	F	O=F	
	10.00	2.05	0.04	6.38	=102.43 — 2.69=	99.74%
	10.69	1.91	0.04	6.11	=102.80 — 2.57=	100.23
	10.37	3.15	--	5.02	=102.18 — 2.11=	100.07
	10.65	1.60	--	7.06	=102.60 — 2.97=	99.63
	10.30	1.74	--	6.71	=102.83 — 2.82=	100.01

Cookeite from Pala has also been analysed by Schaller[7].

SiO_2	Al_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°
35.53	44.23	tr.	tr.	tr.	2.73	2.11	0.31	0.61	13.57

F	O=F	
1.46	=100.55 — 0.61=	99.95%

Colorless and deep pink cookeite is found in pockets at the Victor mine, Rincon, coating quartz, lepidolite, orthoclase, albite and kunzite, and as pseudomorphs after kunzite, Rogers[3].

220. PHLOGOPITE—Magnesia Mica.

Silicate of magnesia and alumina, $H_2KMg_3Al(SiO_4)_3$.

Monoclinic. Usually six-sided plates. Cleavage perfect basal. Tough and elastic. Color yellowish brown; sometime greenish and even colorless. H=2.5—3; G=2.78=2.85.

Refractive indices: $\alpha=1.562$; $\beta=1.606$; $\gamma=1.606$.

Fuses on thin edges. Decomposed by sulphuric acid. Gives a little water in closed tube.

A mica similar to biotite, but containing little or no iron.

Inyo County: Phlogopite occurs with scheelite in calc-hornfels at Deep Canyon west of Bishop.

221. BIOTITE—Magnesia-iron Mica.

Silicate of magnesia, iron and aluminium $(H,K)_2(Mg,Fe)_4(Al,Fe)_2Si_4O_{16}$.

Monoclinic. Broad plates, foliated, scaly, micaceous. Cleavage perfect basal. Color black, dark brown, green. Vitreous to pearly luster. H=2.5—3; G=2.7—3.1.

Refractive indices: $\alpha=1.541$; $\beta=1.574$; $\gamma=1.574$.

Decomposable by boiling in sulphuric acid. Very difficult to fuse. Iron-rich varieties become magnetic on heating.

The dark brown and black biotite mica is the commonest of all the micas. It is generally a prominent constituent of nearly all eruptive rocks and also of gneisses and schists. It is present as a rock-forming mineral in every county.

Lepidomelane is very black iron mica usually classed as biotite.

Alpine County: A black biotite from a quartz-monzonite rock at Blood Station was analysed by Valentine, Turner[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO	Li_2O
35.62	2.61	15.24	4.69	13.67	0.74	0.95	tr.	0.26	12.70	tr.

Na_2O	K_2O	H_2O at 105°	H_2O ab. 105°	P_2O_5	F	
0.50	7.72	0.94	4.36	none	none	=100.00%

Amador County: Biotite from a pyroxene gneiss on the north fork of the Mokelumne River was analysed by Valentine, Turner[7].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	SrO	BaO	MgO	Li_2O	Na_2O
36.62	3.03	14.37	4.04	17.09	0.40	1.48	tr.	0.33	9.68	tr.	0.45

K_2O	H_2O at 105°	H_2O ab.105°	P_2O_5	F		O=F	
8.20	0.90	3.26	none	0.10	=99.95	—0.04	=99.91%

Mariposa County: 1. Black biotite from biotite-granite of El Capitan, Yosemite Valley, was analysed by Valentine; and, 2. Brown biotite

from quartz-monzonite on Tioga road, southeast of Mount Hoffman, was analysed by Hillebrand, Turner[7].

	SiO_2	TiO_2	Al_2O_3	V_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	NiO	CoO	CaO	SrO
1.	35.64	1.12	18.62	--	--	5.54	14.60	0.79	--	--	0.90	--
2.	35.75	3.16	14.70	0.05	tr.	4.65	14.08	0.45	0.02		0.17	?

	BaO	MgO	Li_2O	Na_2O	K_2O	H_2O at 100°	H_2O ab. 100°	P_2O_5	F	O=F
1.	tr.	9.72	tr.	0.38	9.22	0.48	2.54	0.20	0.26	=100.01 — 0.11=99.90%
2.	0.12	12.37	--	0.32	9.19	1.03	3.64	0.03	0.17	= 99.90 — 0.07=99.83%

Riverside County: Biotite is a constituent of the granodiorite at Crestmore. Found associated with carbonate rocks of Eagle Mountain. Long and slender rods and plates of black biotite occur in a granitic rock in the city quarry at Riverside.

San Diego County: Plates, fairly large, of black biotite occur near Jacumba.

222. ROSCOELITE—Vanadium Mica.

Hydrous silicate of vanadium, aluminum and potassium, $H_2K(Mg,Fe)_3(Al,V)_4(SiO_4)_{12}$.

Minute scales often in stellate groups. Cleavage perfect basal. Color clove-brown, greenish brown or brownish green. Pearly luster. Soft. G=2.92 — 2.94.

Refractive indices: $\alpha = 1.610$; $\beta = 1.685$; $\gamma = 1.704$.

Insoluble, but fusible. Like biotite in its reactions, but in addition gives a green bead of vanadium with phosphorous salt.

Vanadium is a rare constituent of some igneous rocks, and is occasionally found in small amounts in biotite. Roscoelite is unique in having a large percentage of vanadium in place of iron and thus forming a vanadium-mica. It is a very rare mica, and few specimens of it are now in existence, since most of the material was destroyed for the gold which was thickly interlaminated with the micaceous plates.

El Dorado County: Layers from a tenth to a half inch in thickness of a dark green micaceous mineral, thickly interlaminated with gold, were found at the Stuckslager or Sam Sim's mine on Granite Creek, near Coloma, which proved to be a new mineral and was named by James Blake[2], in 1874. The new mica was later described and analysed by Genth[6], Roscoe[1], and Hillebrand, Turner and Clarke[1].

	SiO_2	TiO_2	V_2O_3	V_2O_5	V_6O_{11}	Al_2O_3	Fe_2O_3	Mn_2O_3	FeO
Genth	47.82				21.36	12.60			3.30
	47.69				22.02	14.10			1.67
Roscoe	41.25			28.60		14.14	1.13	1.15	
Hillebrand	45.17	0.78	24.01			11.54			1.60

	MgO	CaO	Na_2O	K_2O	Li_2O	H_2O		
Genth	2.43	tr.	0.33	8.03	tr.	5.13	=100.00%	
	2.00	tr.	0.19	7.59	tr.	4.96	=100.22	G=2.938
Roscoe	2.01	0.61	0.82	8.56		3.35	=101.62	
Hillebrand	1.64	--	0.06	10.37	tr.	4.69	= 99.86	

Several hundred pounds of the mineral were also found in Big Red Ravine, near the old Sutter Mill, where gold was first discovered, but the masses were destroyed for their gold values, Hanks[6].

BRITTLE MICAS.

The brittle micas include several micaceous minerals whose plates or scales are non-elastic and easily break when bent. Otherwise they resemble the common micas. They are characteristic of the crystalline gneisses and schists. All of them probably occur in the State, but only margarite, xanthophyllite, chloritoid, and ottrelite have been observed.

223. MARGARITE.

Hydrous silicate of calcium and aluminium, $H_2Ca_2Al_4Si_2O_{12}$.

Monoclinic. Scaly, micaceous. Cleavage perfect basal. Color grayish. pink. Pearly luster. H=3.5 — 4.5; G=2.99 — 3.08.

Refractive indices: α =1.632; β=1.643; γ=1.645.

Insoluble, but is somewhat fusible. Similar to the micas, but its flakes are not elastic and thus differ from true micas.

Margarite is prominent in the glaucophane rocks and has been observed in several localities.

Calaveras County: Soft silver-white pearly masses of flaky material occur in the Gold Cliff mine at Angels and in some of the other mines of the Mother Lode which bear a strong resemblance to margarite, and are probably this mineral.

Marin County: Mentioned by Ransome[2] as an associate of the lawsonite at Reed Station. Much of this, however, is muscovite, Eakle[6].

San Mateo County: A constituent of the schists of Belmont, Murgoci[1].

Santa Clara County: Occurs in the eclogite of Oak Ridge, J. P. Smith[1].

Sonoma County: A constituent of the glaucophane gneiss of Melitta, near Santa Rosa, Murgoci[1].

224. XANTHOPHYLLITE.

Hydrous silicate of aluminium, calcium and magnesium, $H_8(Mg,Ca)_{14}Al_{16}Si_5O_{52}$.

Monoclinic. Tabular crystals parallel to the base. Perfect basal cleavage. Color leek-green, bottle-green. Vitreous luster. H=4.6; G=3.09.

Refractive indices: α =1.649; β=1.660; γ=1.661.

Infusible and insoluble. Gives water when intensely heated in a closed tube. Plates are not flexible.

A very rare green platy mineral belonging to the brittle micas, resembling green muscovite.

Riverside County: Abundant platy crystals of xanthophyllite occurred in the blue calcite of the cement quarry at Crestmore, intimately associated with monticellite. An analysis by Eakle gave:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O	
16.84	44.68	2.85		14.14	16.24	5.07 = 100.62%	G = 3.081
16.74	42.70	2.85	0.41	13.09	20.03	4.49 = 100.31%	

225. CHLORITOID.

Hydrous silicate of iron, magnesium and aluminium, $H_2(Fe,Mg)Al_2SiO_7$.

Monoclinic. Foliated massive, scales. Cleavage perfect basal. Color dark gray, grayish black, grass green. Pearly to vitreous luster. H = 6.5; G = 3.52 — 3.57.

Refractive index: $\beta = 1.75$.

Insoluble and infusible. Plates are flexible, but not elastic. Gives much water in a closed tube.

Calaveras County: Dark green chloritoid has been found in some of the schists of this county.

226. OTTRELITE.

Hydrous silicate of iron, manganese and aluminium, $H_2(Fe,Mn)Al_2Si_2O_9$.

Monoclinic. Hexagonal-shaped scales. Cleavage perfect basal. Color blackish gray, black. Vitreous luster. H = 6 — 7; G = 3.3.

Insoluble and infusible. Yields water in a closed tube.

Ottrelite schists appear to be rare in the State.

Siskiyou County: A specimen of ottrelite schist has come from the vicinity of Yreka.

CHLORITES.

Under the name chlorite are included several species having a micaceous structure with the flakes flexible but not elastic. The chlorites are prominent in many schists, forming chlorite-schists. They are also formed as secondary alteration products of hornblende and pyroxene rocks, and as such are very common throughout the State. They are characteristically dark leek-green or brown in color. As a general thing the various kinds of chlorite have not been differentiated.

227. CLINOCHLORE.

Hydrous silicate of magnesium and aluminium, $H_8Mg_5Al_2Si_3O_{18}$.

Monoclinic. Scaly, earthy, compact. Cleavage perfect basal. Color deep grass-green, olive-green, rose-red. Pearly luster. H = 2 — 2.5; G = 2.65 — 2.78.

Refractive indices: $\alpha = 1.585$; $\beta = 1.586$; $\gamma = 1.596$.

Insoluble in hydrochloric acid and practically infusible. Decomposed by boiling sulphuric acid. Gives water in closed tube when intensely heated. Plates are flexible, but without elasticity, thus differing from true micas.

Clinochlore occurs as an alteration product of magnesian-iron minerals and is common in schists.

Kotschubeite is a rose-red variety of clinochlore containing chromium and is associated with chromite in serpentine rocks.

Calaveras County: Some pink chrome chlorite has been found near Angels.

Nevada County: Fine chrome chlorite, pink and green, occurs on chromite at the Red Ledge mine, Washington district.

Placer County: Rose-red kotschubeite also occurs on chromite in the serpentine of Green Valley, above Dutch Flat, Lindgren[2]. It has been analysed by Melville[1].

SiO_2	Al_2O_3	Cr_2O_3	FeO	NiO	CaO	MgO	H_2O at 105°	H_2O ab. 105°
31.74	6.74	11.39	1.23	0.49	0.18	35.18	0.37	12.68

Riverside County: Clinochlore occurs in pale green flakes with vesuvianite in the limestone at Crestmore.

Siskiyou County: A chrome chlorite occurs near Dunsmuir.

228. PENNINITE—Rhodochrome.

Hydrous silicate of iron, magnesium and aluminium, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.

Monoclinic. Plates, scales, scaly massive. Cleavage perfect basal. Color emerald-green, grass-green, violet, rose-red. Pearly luster. H=2—2.5; G=2.6—2.85.

Refractive indices: ϵ=1.579; ω=1.576.

Same reactions as given by clinochlore.

Penninite is similar to clinochlore with more iron in its composition. *Kämmererite* is a peach-blossom red variety associated with chromite.

Alameda County: Reddish violet kämmererite occurs with chromite on Cedar Mountain at the Mendenhall mine, Rogers[5].

Del Norte County: Kämmererite has been observed coating chromite from this county.

Placer County: Kämmererite occurs on chromite in Green Valley above Dutch Flat. Kämmererite coats the chromite about seven miles south of Newcastle.

San Benito County: Red kämmererite occurs on chromite associated with uvarovite at New Idria, Brush[1].

Shasta County: Kämmererite coats chromite in Little Castle Creek mine, near Dunsmuir.

229. PROCHLORITE.

Hydrous silicate of magnesium, iron and aluminium.

Monoclinic. Scaly, foliated, granular, massive. Cleavage perfect basal. Color green, blackish green, brown. Pearly luster. H=1—2; G=2.78—2.96.

Refractive indices: α=1.606; β=1.606; γ=1.610.

Like clinochlore in its reactions. Iron-rich varieties become magnetic after heating.

Prochlorite is a common chlorite of rocks usually dark green but sometimes brown. Forms large flaky masses in schists.

Butte County: Prochlorite is a constituent of the schists at Forbestown, specimens coming from the Gold Bank mine.

Contra Costa County: Prochlorite was described and analysed from the schists near San Pablo by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	H_2O at 100°	H_2O ab. 100°	
27.38	26.15	0.78	12.70	18.92	--	1.15	1.51	11.44	=100.03%

Riverside County: Green chlorite occurs as an alteration of augite, hornblende and epidote at Crestmore.

230. CORUNDOPHYLLITE.

Hydrous silicate of magnesium and aluminium.

Monoclinic. Plates, lamellar massive. Cleavage perfect basal. Color olive-green, leek-green. Pearly luster. H=2.5; G=2.9.

Refractive indices: $\alpha=1.605$; $\beta=1.607$; $\gamma=1.673$.
Like clinochlore in reactions.

This is a rarer form of chlorite, but probably exists in more localities than are now known.

Riverside County: Corundophyllite has been found at Roggentramp.

231. GRIFFITHITE.

Hydrous silicate of magnesium, aluminum, iron and calcium,
$H_4(Mg,Fe,Ca)_4\ (Al,Fe)_2\ Si_5O_{19}\ 5H_2O$.

Monoclinic? Basal plates and shreds. Cleavage basal. Sectile. Color dark green. H=1; G=2.309.

Refractive indices: $\alpha=1.605$; $\beta=1.607$; $\gamma=1.673$.

Fuses with intumescence to a black magnetic slag. Soluble in hydrochloric acid with gelatinization.

A new member of the chlorite group of silicates and was described by Larsen and Steiger[1].

Los Angeles County: Occurred filling amygdaloidal cavities in basalt at Cahuanga Pass, Griffith Park, Los Angeles.

Analysis by Steiger:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	$-H_2O$	$+H_2O$	TiO_2	
39.64	9.05	7.32	7.83	15.80	2.93	0.71	None	12.31	4.90	None	= 100.49%

232. CHALCODITE—Stilpnomelane.

Hydrous silicate of iron, magnesium and aluminium.

Minute scales. Color black, yellowish and greenish bronze. Brassy to submetallic luster. Flexible. H=3—4; G=2.96.

Refractive index: $\omega=1.69$.

Fuses with difficulty and becomes magnetic. Decomposed by hydrochloric acid, but without forming a jelly. Gives much water in a closed tube.

Chalcodite is a rare brown chlorite, occurring in minute scales, often with a bronze luster.

Inyo County: Occurs as bronze brown flakes on analcite and natrolite in the amygdules of an andesite on the Furnace Creek wash, two miles west of Ryan.

Santa Barbara County: Brown crystals of chalcodite have come from this county.

233. JEFFERISITE.

Hydrous silicate of magnesium, iron and aluminium.

Broad plates, small scales. Cleavage perfect basal. Color dark yellowish brown. Pearly luster. H=1.5; G=2.30.

Refractive indices: ϵ=1.54; ω=1.560.

Rather difficult to fuse, but exfoliates when heated. Soluble in hydrochloric acid, but without gelatinization. Gives water in a closed tube.

Jefferisite is a hydrated mica occurring in dark yellowish brown scales and plates.

Lassen County: Large brown plates of jefferisite occur at Susanville according to Hanks[4].

Mendocino County: Small flakes have been observed in this county.

Tulare County: Hanks[6] mentions jefferisite from this county.

ZEOLITES.

234. HEULANDITE.

Hydrous silicate of calcium and aluminium, $H_4CaAl_2(SiO_3)_6.3H_2O$.

Monoclinic. Platy crystals. Color white, brick-red. Perfect clinopinacoidal cleavage. H=3.5—4; G=2.18—2.2.

Refractive indices: α=1.498; β=1.499; γ=1.505.

Intumesces or boils when fused. Soluble in hydrochloric acid, but does not yield a jelly on evaporation. Gives water in a closed tube.

A zeolite formed as a secondary mineral in cavities and seams of basic volcanic rock, usually with stilbite, chabazite and other zeolites. It is probably present in the basaltic areas of the State, but has not been reported.

Plumas County: Occurs as a hydrothermal mineral in the druses of the pegmatites at Engels, Graton and McLaughlin[1].

San Diego County: Occurs sparingly as pale brown crystals with stilbite at Rincon. Forms: (010), (001), (201), ($\bar{2}$01), (110), Rogers[3].

235. PHILLIPSITE.

Hydrous silicate of aluminium, calcium and potassium.
$(K_2,Ca)Al_2Si_4O_{12}.4H_2O$.

Monoclinic. Usually in groups of twinned crystals. Color white to red. Translucent to opaque. H=4—4.5; G=2.2.

Refractive index: β=1.57.

Fuses easily to a white enamel. Gelatinizes with hydrochloric acid.

A rarer member of the zeolites.

Plumas County: One of the zeolites at the Engels mine.

236. LAUMONTITE.

Hydrous silicate of calcium and aluminium, $H_4CaAl_2Si_4O_{14}.2H_2O$.

Monoclinic. Radiating or divergent columnar. Cleavage perfect basal and clinopinacoidal. Color white. Vitreous luster. H = 3.5 — 4; G = 2.25 — 2.36.

Refractive indices: $\alpha = 1.513$; $\beta = 1.524$; $\gamma = 1.525$.

Fuses easily to a glass and shows the reddish flame of calcium; soluble in hydrochloric acid and yields gelatinous silica. Gives water in a closed tube.

A zeolite occurring in cavities of basic volcanic rock, usually with other zeolites.

Plumas County: Occurs as a hydrothermal zeolite at the Engels mine.

Riverside County: Soft fibrous masses of snow-white color coat some of the green prehnite at the Crestmore quarry. Analysis gave:

SiO_2	Al_2O_3	CaO	MgO	H_2O
53.49	22.01	10.80	tr.	13.39 = 99.69%

San Bernardino County: Fibrous white laumontite has been found near the Grant mine, on the right bank of the Cucamonga Canyon.

San Diego County: Small amounts are associated with the axinite crystals of Moosa Canyon near Bonsall, Schaller[1]. The mineral also occurs at Rincon in minute radiate crystals with the forms (110), and (201), and as a pseudomorph after stilbite, Rogers[3].

237. STILBITE.

Hydrous silicate of sodium, calcium and aluminum, $H_4(Na_2,Ca)Al_2Si_6O_{18}.4H_2O$.

Monoclinic. Commonly in sheaf-like aggregates, lamellar. Cleavage perfect clinopinacoidal. Color white, yellowish brown. Vitreous to pearly luster. H = 3.5 — 4; G = 2.09 — 2.20.

Refractive indices: $\alpha = 1.494$; $\beta = 1.498$; $\gamma = 1.500$.

Fuses with exfoliation. Soluble in hydrochloric acid, but does not yield a jelly when evaporated to dryness. Gives water in a closed tube.

A common zeolite occurring usually as sheaf-like aggregates in cavities and seams of volcanic rock. It is more common in the State than what has been reported.

Fresno County: Found in lava in the North Fork mining district.

Modoc County: Specimens of lava with amygdules filled with stilbite and natrolite have come from this county.

Plumas County: White and brown stilbite occurs with chabazite and natrolite in the cavities of basic rock at Engels.

San Diego County: Occurs as sheaf-like aggregates of small brown crystals at the Victor mine near Rincon, Rogers[3].

Santa Barbara County: Found in the San Pablo Mountains of Santa Rosa Island.

Tulare County: Occurs in volcanic rock at Mount Kaweah.

238. CHABAZITE.

Hydrous silicate of calcium, sodium and aluminium $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.

Hexagonal, rhombohedral. Crystals nearly cubic. Color white, flesh-red. Vitreous luster. H=4—5; G=2.08—2.16.

Refractive indices: ϵ=1.482; ω=1.480.

Fuses with light swelling. Decomposed by hydrochloric acid, but without gelatinization. Gives much water in a closed tube.

A zeolite occurring as a secondary mineral in cavities of basic volcanic rock, usually in rhombohedrons nearly cubic in shape.

Nevada County: Occurs in colorless crystals with epidote and pyrite at the Star placer mine, Grass Valley, Lindgren[6].

Plumas County: Found as rhombohedrons in olivine basalt at the Dodson mine, Mooreville Ridge, Turner[1]. Present as one of the hydrozeolites at the Engels mine, Graton and McLaughlin[1].

239. ANALCITE.

Hydrous silicate of sodium and aluminium, $NaAlSi_2O_6.H_2O$.

Isometric. Crystals usually trapezohedrons. Sometimes quite large. Colorless to white. Vitreous luster. H=5—5.5; G=2.22—2.29.

Refractive index: n=1.487.

Fuses to a clear glass and shows bright yellow flame of sodium. Soluble in hydrochloric acid, but does not gelatinize. Gives a small amount of water in a closed tube.

A zeolite occurring as a secondary mineral in volcanic rocks and often in large trapezohedral crystals. It is also found as an original constituent in some diabases and basalts.

Alameda County: Occurs as one of the secondary minerals in the cavities of andesitic rock on the Berkeley Hills.

Inyo County: An amygdaloidal mass of andesite occurs on the Furnace Creek wash, about two miles west of Ryan with its amygdules lined with clear, colorless trapezohedrons of analcite, needles and white bunches of natrolite and bronze-brown flakes of chalcodite, Foshag.

Plumas County: Occurs as a hydrothermal mineral in the druses of the pegmatites at Engels, Graton and McLaughlin[1].

Santa Barbara County: A constituent of the teschenite of Point Sal and was analysed by Fairbanks[3][4].

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Ign.		
54.40	23.04	0.21	13.33	0.19	8.46	=99.63	G=2.26

240. NATROLITE.

Hydrous silicate of sodium and aluminium, $Na_2Al_2Si_3O_{10}.2H_2O$.

Orthorhombic. Long needles, columnar, fibrous. Cleavage perfect prismatic. Colorless to white. Vitreous luster. H=5—5.5; G=2.2—2.25.

Refractive indices: $\alpha=1.480$; $\beta=1.482$; $\gamma=1.493$.

Fuses quietly to a clear glass and gives yellow flame of sodium. Soluble in hydrochloric acid and yields much jelly on evaporation. Gives water in a closed tube.

A zeolite formed as a secondary mineral in cavities of igneous rock and sometimes as veins in such rock. It usually occurs fibrous or acicular, associated with stilbite and other zeolites.

Alameda County: Needles of natrolite occur with analcite in the amygdules of the andesitic rock on the Berkeley Hills.

Inyo County: Occurs in slender colorless needles and white fibrous bunches in the amygdules of an andesite on the Furnace Creek wash, two miles west of Ryan. Associated with analcite and chalcodite, Foshag.

Modoc County: Slender needles occur with stilbite in the lava of this county.

Plumas County: Occurs as a hydrothermal zeolite in the druses of the pegmatite at Engels.

San Benito County: A large vein of white natrolite occurs near the headwaters of the San Benito River on the west side of the Diablo Range about twenty-five miles north of Coalinga, in which crystals of benitoite and neptunite are included. The natrolite is mostly granular although some crystals with the forms (110) and (111) occur. The occurrence has been described by Louderback[1][2] with analysis by Blasdale.

SiO_2	Al_2O_3	Na_2O	H_2O	
47.69	27.14	15.74	9.56	=100.13%

Sierra County: Found on Herkin's ranch north of Sierra.

Sonoma County: In the rocks of the Sonoma Mountains not far from Petaluma.

241. MESOLITE.

Hydrous silicate of sodium and calcium, $m\ Na_2Al_2Si_3O_{10}2H_2O\ n\ CaAl_2Si_3O_{10}.3H_2O$.

Triclinic. Prismatic crystals. Generally silky fibrous crusts. Cleavage perfect prismatic. Colorless to white. Vitreous to silky luster. H=5; G=2.2—2.4.

Refractive indices: $\alpha=1.505$; $\beta=1.505$; $\gamma=1.506$.

Fuses with intumescence to a white vesicular glass. Soluble with gelatinization. Gives much water in a closed tube.

A zeolite occurring generally as silky fibrous crusts as a secondary mineral in cavities of basaltic rock.

Lassen County: Observed in the lava of Lassen Butte.

Shasta County: Found near Redding.

Ventura County: Observed in the basalt of the Pinos Mountains.

242. THOMSONITE.

Hydrous silicate of aluminium, sodium and calcium, $(Na_2,Ca)Al_2Si_2O_8.2\frac{1}{2}H_2O$.

Orthorhombic. Usually radiate fibrous in spherical forms. Cleavage perfect basal. Snow-white to brown. H=5—5.5; G=2.3—2.4.

Refractive indices: $\alpha=1.497$; $\beta=1.503$; $\gamma=1.525$.

Fuses very easily to a white enamel. Gelatinizes with hydrochloric acid.

Found in cavities of vesicular lava with other zeolites.

Plumas County: One of the zeolites occurring at the Engels mine.

NOT GROUPED.

243. GYROLITE.

Hydrous silicate of calcium, $H_2Ca_2Si_3O_9.H_2O$.

Fibrous and lamellar concretions. Colorless and white. Vitreous luster. H=3—4; G=2.39.

Refractive index: $\omega=1.545$.

Fuses easily to a blebby glass and gives the yellowish red flame of calcium. Soluble with some gelatinization. Gives water in a closed tube.

Formed as a secondary mineral in crevices of rocks by the alteration of lime silicates.

San Francisco County: Occurs lining fissures in the rock at Fort Point and was analysed by Schaller[6].

SiO_2	Al_2O_3	CaO	Na_2O	Ign.	
53.47	0.22	32.00	1.25	13.21	=100.15%

Santa Clara County: Fibrous gyrolite occurred in the crevices of the cinnabar mine at New Almaden, associated with apophyllite and bituminous matter, which was analysed by Clarke[2].

SiO_2	$Al_2O_3Fe_2O_3$	CaO	K_2O	Na_2O	F	Ign		F—O	
52.54	0.71	29.97	1.56	0.27	0.65	14.60	=100.30	—0.27	=100.03%

244. JURUPAITE.

Hydrous silicate of calcium and magnesium, $H_2(Ca,Mg)_2Si_2O_7$.

Monoclinic. Fibrous, radiating. Snow-white color. H=1—4; G=2.75.

Refractive indices: $\alpha=1.568$; $\gamma=1.576$.

Fuses easily to a clear white glass. Easily soluble without gelatinization.

A new mineral formed by hydrothermal metamorphism of limestone.

Riverside County: Occurs with bluish calcite and grossularite garnet at the Crestmore limestone quarry and was named, analysed and described as a new mineral by Eakle[12]. Analysis:

SiO_2	CaO	MgO	H_2O	
48.87	38.66	4.19	7.89	= 99.61%

245. APOPHYLLITE.

Hydrous silicate of calcium and potassium, $H_7KCa_4(SiO_3)_8.4\frac{1}{2}H_2O$.

Tetragonal. Square prisms, pyramids, massive. Cleavage perfect basal. Colorless, white, pale violet, greenish, yellowish. Pearly luster on base. H = 4.5 — 5; G = 2.3 — 2.4.

Refractive indices: $\epsilon = 1.537$; $\omega = 1.535$.

Soluble in hydrochloric acid, but without gelatinization. Fuses with swelling to white enamel and shows the violet flame of potassium. Gives much water in a closed tube.

A secondary mineral found in cavities of volcanic rock.

Plumas County: Crystals occur in cavities of basalt at the Buckeye mine, near Onion Valley.

Riverside County: Cavities in the massive wollastonite at Crestmore are lined with small crystals of colorless and white apophyllite. The forms identified are: (100), (111), and (001).

San Francisco County: A few crystals were found at Fort Point with the forms (111) and (100), but most of them were largely changed into quartz pseudomorphs, Schaller[3].

Santa Clara County: Found at New Almaden in large crystals associated with gyrolite and bituminous matter, Clarke[2].

246. XONOTLITE—Eakleite.

Hydrous silicate of calcium, $5CaSiO_3.H_2O$.

Monoclinic. Compact fibrous. Color snow-white or pink. Vitreous to silky luster. H = 4—6; G = 2.705.

Refractive indices: $\alpha = 1.583$; $\beta = 1.583$; $\gamma = 1.593$.

Fuses easily to a glassy globule. Easily soluble in hydrochloric acid with the separation of flaky silica. Yields water at a high heat.

A white mineral resembling pectolite in structure.

Santa Barbara County: A mineral specimen collected years ago from somewhere in the vicinity of Santa Ynez and labeled wollastonite, was found by Larsen[5] to differ optically from that mineral, and, on the supposition that it was a new mineral, he proposed the name of *eakleite* for it. It apparently agrees with xonolite in composition. Analyses of the mineral by Eakle gave:

SiO_2	Fe_2O_3	CaO	MgO	$Na_2O.K_2O$	H_2O	
50.45	0.98	45.51	tr.	None	3.25	= 100.17%
49.90	1.11	45.39	tr.	None	3.11	= 99.51%

247. OKENITE.

Hydrous silicate of calcium, $H_2CaSi_2O_6.H_2O$.

Finely fibrous and acicular. Color snow-white. Luster pearly. H=4.5—5; G=2.28.

Refractive indices: $\alpha=1.512$; $\beta=1.514$; $\gamma=1.515$.

Soluble with slight gelatinization in a hydrochloric acid solution. Fuses to a glass and colors flame reddish. Gives water in a closed tube.

Riverside County: The wilkeite in the limestone at Crestmore is often altered to a white fibrous material, which was similar to okenite in its optical properties. Eakle and Rogers[1]. Radiating botryoidal coatings of okenite occur on apophyllite, evidently as an alteration product, at Crestmore. Forms and analysis are by Foshag. Forms: (110), (010), (011). Analysis:

SiO_2	CaO	H_2O
56.17	26.10	16.83 = 99.10%

248. INESITE.

Hydrous silicate of manganese and calcium, $2(Mn,Ca)\ SiO_3.H_2O$.

Triclinic. Prismatic crystals, sometimes fibrous radiating or spherulitic. Cleavage perfect brachy-pinacoidal. Color rose-red. Vitreous luster. H=6; G=3.03.

Refractive indices: $\alpha=1.609$; $\beta=1.636$; $\gamma=1.644$.

Inesite is considered quite rare, since it has been reported only from one locality, but it appears to be a common associate of the psilomelane in several of the mines of the State.

Alameda County: Rose-red veins of the mineral intersect the rhodochrosite, associated with bementite, at the Newhall or Bailey mine, ten miles southeast of Livermore, on the Arroyo Mocho.

Mendocino County: In the Rhodochrosite Claim, Mt. Sanhedrin, situated about eight miles from Hearst, inesite veins are associated with bementite and neotocite.

San Joaquin County: The mineral appears to be common at the old Ladd mine, associated with bementite.

Stanislaus County: The gray rhodochrosite of the Cummings or Winship properties is intersected by veinlets of rose-red inesite associated with bementite. The forms observed on the inesite crystals are: $(1\bar{1}0)$, (100), (010) and (001), Foshag and Eakle.

249. GANOPHYLLITE.

Hydrous silicate of aluminium and manganese, $7MnO.Al_2O_3.8SiO_2.6H_2O$.

Monoclinic. Tabular crystals. Color yellowish to brown. Vitreous luster. Perfect basal cleavage. H=4—4.5; G=2.84.

Refractive indices: $\alpha=1.705$; $\beta=1.729$; $\gamma=1.730$.

Soluble in strong acid. Gives green bead of manganese with sodium carbonate.

A very rare mineral not known to occur elsewhere in this country.

Santa Clara County: One of the minerals of the manganese boulder found near Alum Rock Park, five miles east of San Jose. Occurred in seams with barite as brownish yellow tabular crystals, Rogers[9].

250. CRESTMOREITE.

Hydrous silicate of calcium, H_2CaSiO_4.

Fibrous, compact. Snow-white. Vitreous to dull luster. H=3; G=2.22.

Refractive indices: $\alpha=1.593$; $\beta=1.607$; $\gamma=1.603$.

Fuses quietly and easily to a slightly vesicular glass. Easily soluble with separation of flocculent silica. Gives reaction for sulphate, phosphate and carbonate.

A new silicate formed by hydrothermal metamorphism of limestone.

Riverside County: Occurs as a new mineral at the Crestmore limestone quarry, formed as an alteration of wilkeite and also as a direct crystallization; named for the locality, described and analysed by Eakle[10]. Analysis gave:

SiO_2	CaO	P_2O_5	SO_3	CO_2	Loss
36.12	42.71	2.38	2.42	1.16	14.98
38.30	41.20	3.50	1.25	----	15.17
34.42	43.54	3.50	2.24	----	16.24

251. RIVERSIDEITE.

Hydrous silicate of calcium, $Ca_2Si_2O_6.H_2O$.

Fibrous: White, silky luster. H=3; G=2.64.

Refractive indices: $\alpha=1.595$; $\beta=1.603$; $\gamma=1.60$.

Fuses easily to a white glass. Easily soluble with separation of flocculent silica.

A new mineral formed by hydrothermal metamorphism of limestone.

Riverside County: Found at the Crestmore limestone quarry in association with vesuvianite. Named for the county, analysed and described by Eakle [10]. Analysis gave:

SiO_2	CaO	P_2O_5	SO_3	H_2O
41.26	44.58	3.84	1.84	8.11 = 99.63%

252. PLAZOLITE.

A hydrous silicate of calcium and aluminium.
$3\,CaO.\,Al_2O_3.\,2\,(SiO_2.CO_2).\,2H_2O.$

Isometric. Small octahedrons. Colorless, vitreous luster. Brittle. H = 6.5; G = 3.129.

Refractive index: $n = 1.710$.

Fusible, and easily soluble in hydrochloric acid, with separation of silica without gelatinization. Gives water in a closed tube.

Only a few specimens of this new mineral were found. It was named, analysed and described by Foshag[3].

Riverside County: Occurred as minute crystals with vesuvianite in the limestone quarry at Crestmore. Analyses:

	I	II	III
SiO_2	24.13	23.85	25.06
Al_2O_3	23.66	22.77	24.63
CaO	40.22	40.13	40.13
MgO	0.12		tr.
H_2O	12.21	9.39	9.04
CO_2		3.41	1.13
	100.34	99.55	99.99

253. SERPENTINE.

Hydrous silicate of magnesium, $H_4Mg_3Si_2O_9$.

Monoclinic. Commonly massive, compact to fibrous. Color leek-green, oil-green, brown, black. Greasy luster. Feels smooth, sometimes greasy. H = 2.5 — 4; G = 2.5 — 2.65.

Refractive indices: $\alpha = 1.490$; $\beta = 1.502$; $\gamma = 1.511$.

Infusible. Soluble in hydrochloric acid, but without forming a jelly. Gives water in a closed tube. A heavy precipitate of magnesia is obtained by sodium phosphate.

Serpentine is one of the commonest minerals and also rocks of the State. It occurs in every county, and probably all the varieties are present. It is a common alteration product of basic igneous rocks rich in magnesian silicates, and it has all been formed by alteration and metamorphism of such rocks. Besides the ordinary massive serpentine, *retinolite, porcellophite, marmolite, chrysotile, picrolite, antigorite* and *metaxite* have been observed in petrographical literature. The only variety of commercial importance is the fibrous or asbestiform variety known as chrysotile, or asbestos, which occurs as narrow veins in the massive material, mostly too narrow to be of value The massive serpentine ranges in color from light green to greenish black, but very little of it can be utilized as an ornamental stone on account of its foliated and sheared structure. Turner and Melville[1] give several analyses of serpentine rock from Mount Diablo.

Serpentine is abundant in the Coast Range from San Diego to Del Norte County and also on the west flank of the Sierras.

Amador County: A fine mottled serpentine occurs 1½ miles west of Sugar Loaf Mountain. Broad sheets and long fibers of chrysotile occur in serpentine in the American River Canyon near Towle. Chrysotile asbestos occurs in small veins in serpentine 2½ miles east of Ione. Deposit of chrysotile has been quarried two miles west of Plymouth. Veins of chrysotile occur in a dark green serpentine at the Mace mine, 2½ miles east of Ione.

Calaveras County: Veins of chrysotile occur in the serpentine of the ridge northwest of the Stanislaus River, about six miles southeast of Copperopolis, forming a large deposit.

El Dorado County: Veins of fibrous chrysotile are found at Forest Hill. Good quality of fibrous chrysotile occurs near Georgetown.

Fresno County: Serpentine containing veinlets of chrysotile occur near Lanare.

Inyo County: Long fibers of asbestos occur at Cerro Gordo.

Kern County: Chrysotile veins occur in serpentine in Jawbone Canyon.

Lake County: Becker[1] gives analyses by Melville of the serpentine at Sulphur Bank. 1. Black; 2. Light green.

	SiO_2	Al_2O_3	Cr_2O_3	FeO	MnO	NiO	CaO	MgO	H_2O	
1.	39.64	1.30	0.29	7.76	0.12	0.33	--	37.13	13.81	=100.38%
2.	41.86	0.69	0.24	4.15	0.20	tr.	--	38.63	14.16	= 99.93

Fibrous chrysotile in serpentine occurs eight miles southeast of Lower Lake. Some occurs near Siegler Springs and in the mountains near Bartlett Springs.

Mariposa County: Small veins of chrysotile occur in the serpentine near Mariposa.

Napa County: Chrysotile asbestos in short fibers occurs in Steel Canyon, Berryessa Road.

Nevada County: Massive serpentine is common in the Grass Valley and Nevada City region. Zones of short fibrous chrysotile occur in the Washington district on the South Yuba River. The picrolite variety of serpentine occurs in Maryland mine, Grass Valley.

Placer County: Long fibers of chrysotile occur at Wisconsin Hill, Iowa Hill and Arizona Flat. Specimens of serpentine carrying asbestos come from Cisco.

Plumas County: Diller[3] gives an analysis by Melville of serpentine from Greenville.

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O	
39.14	2.08	4.27	2.04	tr.	39.84	12.70	=100.07%

Riverside County: Small grains of serpentine occur in the white crystalline limestone at Crestmore. Yellowish green nodular masses occur in crystalline limestone on Eagle Mountains.

San Benito County: Becker[1] gives an analysis by Melville of a light green marmolite from New Idria.

SiO_2	Al_2O_3	FeO	NiO	CaO	MgO	H_2O	
41.54	2.48	1.37	0.04	--	40.42	14.18	=100.03%

San Francisco County: Newberry[1] gives an analysis of the serpentine of San Francisco.

SiO_2	Al_2O_3	Cr_2O_3	FeO MnO	CaO	MgO	H_2O	
39.60	1.94	0.20	8.45	--	36.90	12.91	=100.00%

Santa Clara County: Small veins of chrysotile occur in the serpentine near New Almaden. Pierolite occurs near Morgan Hill.

Shasta County: Large fibrous masses of chrysotile asbestos occur near Sims Station. Massive serpentine containing chrysotile asbestos veinlets is found about three miles east of Castella Station.

Sierra County: Serpentine asbestos occurs on west bank of Goodyear Creek.

Siskiyou County: Massive serpentine occurs on ridge on Cottonwood Mountains at the head of Bogus and Dutch Creeks.

Sonoma County: Fibrous veinlets of asbestos occur in the serpentine near Petaluma and Sebastopol.

Tulare County: A chrysotile variety giving cat's-eye effect and called "satelite" comes from this county. Chrysotile is found in the serpentine east of Lindsay.

Tuolumne County: The serpentine near Chinese and Montezuma contains small veins of chrysotile.

254. DEWEYLITE.

Hydrous silicate of magnesium, $4MgO.3SiO_2.6H_2O$.

Amorphous. Massive, gum-like. Color whitish, yellowish, reddish. Greasy luster. H=2—3.5; G=2—2.2.
Like serpentine in its reactions.

A whitish clay-like mass with greasy luster. Its occurrence in the State may be more general than is known.

Santa Clara County: At the big magnesite mine on Red Mountain, crusts of deweylite have been found and described by Rogers[5].

Shasta County: Specimens resembling deweylite have come from this county.

Siskiyou County: Has been reported from this county.

255. GARNIERITE.

Hydrous silicate of magnesium and nickel, $H_2(Ni,Mg)SiO_4.nH_2O$.

Amorphous: Clay-like masses with pod-shaped concretions. Color apple-green. Earthy luster. Soft and friable. G=2.3—2.8.

Refractive index: $n=1.59$.

Infusible, but soluble in hydrochloric acid with separation of silica. Gives with borax a violet bead while hot and brown bead when cold. Gives water in closed tube.

The chief ore of nickel, but deposits of it are not known to occur in this country.

Imperial County: Reported to occur on the south slope of Coyote Mountains, but the size of the deposit is not stated.

256. TALC—Steatite—Soapstone.

Hydrous silicate of magnesium, $H_2Mg_3Si_4O_{12}$.

Monoclinic. Foliated massive to granular and compact massive. Color gray, white, pale green, apple-green, brown. Greasy luster and feel. H=1—1.5; G=2.7—2.8.

Refractive indices: $\alpha=1.539$; $\beta=1.589$; $\gamma=1.589$.

Insoluble and infusible. Gives water in closed tube on intense ignition.

Talc is a very common mineral in the metamorphic areas of the State, forming talc schists and talc gouge in mines. It occurs as a hydration product in the alteration of magnesian silicates, and is often associated with serpentine and with actinolite. The massive soapstone variety is of value and some is quarried in the State. The location of some of the deposits is given, but most of them are of little value.

Alameda County: Light green talc outcrops in the serpentine about twenty miles southeast of Livermore.

Amador County: Talc occurs in the schists near Jackson. Excellent foliated talc occurs at Plymouth. Light green talc occurs on the Tonzi Ranch, six miles northeast of Ione.

Butte County: Soapstone occurs in the vicinity of Flea Valley and Clear Creek. Narrow seams of talc occur in the Big Bend of the North Fork of the Feather River. Gray soapstone near Buck's Ranch. Massive soapstone near Poe Station, thirty miles east of Oroville. Some talc has come from near Swayne.

Calaveras County: Talc seams are found two miles northeast of Angels and on Quail Hill. Deposits 2½ miles west of Murphys and 1½ miles southwest of Vallicita have been utilized to some extent. Massive soapstone occurs four miles east of Valley Springs. Massive soapstone one mile southwest of Vallicita. Large deposit six miles east of Mokelumne Hill on the Calaveras River. Also 2½ miles west of Murphy.

Contra Costa County: An analysis of the talc from the schists near San Pablo was made by Blasdale[1].

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	H_2O at 100°	H_2O ab. 100°	
56.02	9.02	1.10	5.14	24.10	0.60	0.16	4.34	=100.48%

El Dorado County: In the Kelsey district and at Georgetown some talc occurs. Good talc or soapstone occurs near Shingle Springs and near Latrobe.

Fresno County: Talc occurs in schist in Watts Valley and in Kings River Canyon.

Glenn County: Talc seams occur with the serpentine on the eastern border of the county. Specimens have come from near Willows.

Inyo County: Fine greenish and white talc occurs near Keeler. Pure white talc is found at contact of limestone and diorite, eight miles southwest of Zabriskie. White and gray indurated talc occurs in the Darwin district. A deposit of soft silvery talc occurs at Acme Siding. A fine bluish white talc occurs near Keeler, which can be cut into blocks.

Kern County: Steatite occurs on Soapstone Mountain. Good specimens of talc occur near Goler and Randsburg. Foliated masses are found near Kernville.

Los Angeles County: Soapstone is found with serpentine at Empire Landing, Santa Catalina Island. Steatite occurs near Acton in the vicinity of the Red Rover mine.

Madera County: Talc schist from which large blocks of soapstone can be obtained occurs on the north side of San Joaquin River, above Friant.

Marin County: Some talc is found near San Rafael and Taylorville.

Mariposa County: Small amounts of talc are found near Princeton, and in the Lewis District. Gray soapstone occurs near Coulterville.

Napa County: Seams of talc with serpentine are found in the Chiles district. Massive green talc is found on the Fir Hill Ranch, two miles west of Chiles P. O.

Nevada County: Specimens occur in the Grass Valley region.

Placer County: Outcrops of talc occur a few miles north of Colfax. Small amounts of talc have been found near Clipper Gap. Soapstone occurs at Bobtail mine, Rock Creek district.

Riverside County: A white, scaly talc occurs about three miles southwest of Winchester, and near Perris.

Sacramento County: Talc occurs with chromite on Bear Mountain, near Mormon Island.

San Benito County: Some talc is found between San Benito and Clear Creeks.

San Bernardino County: A talcose clay called "rock soap" is found near Waterman. An extensive deposit of silvery white talc occurs along

contact of limestone and diorite near Riggs, 10 miles north of Silver Lake and on Sheep Creek about twenty miles northwest of Silver Lake.

San Diego County: A rock soap is found near National City, at Otay and in Tia Juana Valley. Steatite specimens come from about five miles from Escondido.

Santa Barbara County: Rock soap occurs on the Santa Maria River.

Santa Cruz County: Some talc occurs near Aptos.

Shasta County: Talc is found on Boulder Creek.

Sierra County: Soapstone suitable for slabs has been quarried near Pike City.

Siskiyou County: Talc occurs in several localities associated with the serpentine areas of the county. It is found near Etna, near Fort Jones, near the head of Wolley Creek, near Scott, and in the Cottonwood Mountain. Small quantity occurs in serpentine about thirty miles west of Etna. Large deposit of soapstone south of Marble Mountain near head of Wolley Creek. Deposit in Cottonwood Mountains on divide between Beaver and Bumble Bee Creeks. Large mass of soapstone occurs a few miles southeast of Hamburg Bar.

Sonoma County: A soft green talc is associated with actinolite at Petaluma. A French chalk variety is found at Pine Flat.

Tehama County: Soapstone mixed with limonite has come from Paskenta.

Trinity County: Light gray soapstone occurs on Brown's Mountain.

Tulare County: Specimens of talc are found near Visalia. Greenish massive soapstone occurs in large deposit eight miles east of Lindsay. Analysis:

SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Ign
57.34	3.08	5.30	0.20	1.72	27.26	5.12 = 100.02%

Massive talc occurs near Porterville.

Tuolumne County: A greenish white talc is found about nine miles north of Sonora. Talc also occurs at Shaw's Flat and on Yankee Hill. A deposit of talc occurs near Shawmut.

Yuba County: Soapstone has been quarried for local use below Weed's Point near Camptonville and in the vicinity of Challenge, and Oak Valley.

257. SEPIOLITE—Meerschaum.

Hydrous silicate of magnesium, $H_4Mg_2Si_3O_{10}$.

Compact. Earthy texture and smooth feel. Color white. Dull luster. H=2—2.5; G=2. When dry floats on water.

Refractive indices: $\alpha=1.519$; $\beta=1.52$; $\gamma=1.528$.

Difficult to fuse. Heated in closed tube, gives off water. Moistened with cobalt nitrate and intensely heated, assumes a pink color. Soluble in hydrochloric acid without forming a jelly.

Sepiolite occurs as a compact earthy white mineral with a smooth feel. When dry it floats on water. It is a valuable mineral, but its occurrence in California is doubtful.

Inyo County: Mentioned by Hanks[6] as possibly occurring at the Half Dollar mine.

Kern County: Reported to have been found in this county.

Mariposa County: Found in excellent quality on a copper claim just east of Mariposa.

258. CELADONITE.

Hydrous silicate of iron, magnesium and potassium.

Earthy or in minute scales. Very soft. Color deep olive-green or apple-green. Greasy feel.

Refractive indices: $\alpha=1.625$; $\beta=1.63$; $\gamma=1.638$.

Infusible, but somewhat soluble without gelatinization.

An earthy green mineral usually found in minute scales, having a greasy feel like talc.

San Mateo County: A specimen has come from near San Mateo.

259. PYROPHYLLITE.

Hydrous silicate of aluminium, $H_2Al_2Si_4O_{12}$.

Monoclinic. Radiating fibrous, compact granular, lamellar. Cleavage perfect basal. Color white, apple-green, light brown, gray. Pearly luster. H=1—2; G=2.8—2.9. Soft and greasy like talc.

Refractive indices: $\alpha=1.552$; $\beta=1.588$; $\gamma=1.600$.

Fuses usually with exfoliation. Insoluble in acids. Moistened with cobalt nitrate and intensely heated, assumes a blue color. Gives a little water in closed tube.

Pyrophyllite resembles talc so closely in its properties that it is generally classed as talc. It occurs generally in schists and gneisses, often associated with cyanite.

Agalmatolite is an indurated talc or pyrophyllite often carved into small ornaments.

Alameda County: A radiating fibrous variety occurs near Irvington.

Butte County: Found in rock on Berry Creek.

Inyo County: Occurs near Keeler.

Marin County: A fibrous radiating pyrophyllite has been found on Mount Tamalpais.

Mariposa County: Gray masses of radiating, fibrous rosettes occur at Tres Cerritos, southwest of Indian Gulch, which have been described by Turner[4]. An analysis of the pyrophyllite from this locality has been made by H. C. McNeil.

SiO_2	Al_2O_3	Fe_2O_3	MgO	H_2O at 105°	H_2O ab. 105°	TiO_2	
65.96	28.25	0.18	none	0.14	5.27	tr.	=99.80%

Plumas County: Some pyrophyllite occurs at the Diadem Lode, Meadow Valley.

San Diego County: A mottled pyrophyllite occurs near San Diego. A compact cream-colored agalmatolite with dark red streaks occurs near Encinitas, Rogers[5].

San Luis Obispo County: Some massive pyrophyllite has come from this county.

260. KAOLINITE—Kaolin—Clay.

Hydrous silicate of aluminium, $Al_2O_3.2SiO_2.H_2O$.

Monoclinic. Occurs occasionally in scales and plates but is generally massive, earthy, clay-like. Color white, yellow, red, brown. Vitreous to dull luster. H=2—2.5; G=2.6. Plastic.

Refractive indices: $\alpha=1.561$; $\beta=1.565$; $\gamma=1.567$.

Pure clays are infusible and insoluble, but some not being pure kaolinite, will fuse to a glass and are slightly soluble. Most will turn a blue color when heated intensely after moistening with cobalt nitrate. Give water in a closed tube.

Kaolinite forms the base of clays. It is derived by the alteration of rocks containing aluminium silicates, especially the feldspars, and most good clays come from the alteration of the potash feldspar, orthoclase. As clay it is usually quite impure with iron, sand, and other impurities, thus giving rise to many varieties which may be suitable for one purpose and not for another. Clays possess more or less plasticity, the highly plastic kinds being used for pottery and chinaware while the sandy and less plastic kinds may make bricks and terra-cotta ware.

There are extensive deposits of clay in the State, some of which are utilized. Many analyses of clay are also available, but these analyses and the many occurrences of clay in the State are beyond the scope of this book.

Rock soap and *Mountain soap* are names applied to impure clay-like masses having a soapy feel. They belong perhaps under the species talc, halloysite, or montmorillonite.

Lithomarge is a finely compact variety which might be classed as a halloysite.

Fuller's earth is a sort of non-plastic clay suitable for decolorizing and purifying fats and oils. Its value as fuller's earth depends upon this property, which can be determined only by trial.

Amador County: Banks of white clay containing silica occur two miles north of Carbondale. Good white clay occurs near Ione. Fine pure white kaolinite occurs on the Scully Ranch near Ione.

Calaveras County: Good clay occurs at Valley Springs. Lithomarge occurs near Big Trees.

Lake County: Good quality of clay occurs at the Mt. Sam mine, on Mt. Konocti, southeast of Kelseyville.

Los Angeles County: A deposit occurs six miles west of Saugus.

Napa County: Some has been found at the old Redington Mine, Knoxville.

Riverside County: Fine kaolinite is found in Hagador Canyon. Soft white clay is present as an alteration of the feldspars at the Crestmore quarry.

Solano County: Monterey shales suitable as fuller's earth occur on the Joice Ranch, one-half mile northeast of Vacaville.

Sonoma County: A deposit of white kaolin occurs in a hill about one-quarter mile northeast of Beltane Station. Analyses gave:

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	H_2O
Hard	74.60	0.21	15.97	0.50	tr.	0.18	0.06	8.80=100.32%
Medium	56.29	0.31	31.13	0.59	--	0.05	0.05	11.67=100.09%
Soft	58.10	0.56	26.79	1.17	tr.	0.32	0.05	12.66= 99.65%

261. HALLOYSITE.

Hydrous silicate of aluminium, $H_4Al_2Si_2O_9.H_2O$.

Massive. Earthy clay-like masses. Color white, gray, greenish, reddish. Waxy luster. Slightly plastic. H=1—2; G=2—2.2.

Refractive index: n=1.470—1.57.

Like kaolinite in its blowpipe reactions and indistinguishable from it. Generally classed as clay.

A clay-like material occurring in masses which are indistinguishable from ordinary clay except by an analysis. It is usually less plastic than clay.

Lenzinite is a compact "rock soap" form of halloysite or clay.

Inyo County: Lenzinite has been reported from Owens Valley by Hanks[6]. A banded white and brown halloysite occurs at the Cerro Gordo mine, Rogers[5]. Pure white halloysite or montmorillonite occurs at Shoshone.

Kern County: Occurs near Piute Mountains.

Lassen County: Halloysite occurs at Hayden Hill.

Mono County: Halloysite was analysed from the Detroit mine, near Mono Lake, by Clarke[1].

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	H_2O	
42.91	38.40	tr.	0.60	1.50	18.00	=101.05%

San Bernardino County: Near Victorville.

San Diego County: Massive pink halloysite occurs at Pala with the gem tourmaline and has been analysed by Schaller[3].

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	Li_2O	Na_2O	K_2O
43.62	none	35.55	0.21	0.26	1.02	0.19	0.23	0.19	0.03

H_2O at 107°	H_2O ab. 107°	
6.63	12.25	=100.18%

The rock-soap from Otay used for oil filtration is montmorillonite. Locally called "otaylite."

Ventura County: An analysis of lenzinite from this county has been made by Merrill. White earthy halloysite occurs near Nordhoff.

262. MONTMORILLONITE.

Hydrous silicate of aluminium, $H_2Al_2Si_4O_{12}.nH_2O$.

Massive, clay-like. Color rose-red. Soft.

Refractive index: $\beta=1.560$.

Like kaolinite in its reactions.

A massive clay-like mineral indistinguishable from clay except by analysis.

Inyo County: Found in Death Valley.

San Bernardino County: A clay mass, probably montmorillonite, occurs near Needles; also from near Yerma and Ludlow. Deposit occurs about seventy miles north of Ludlow.

San Diego County: Some of the pink clay associated with the tourmaline of Pala may be in part montmorillonite. Mentioned by Goodyear[1] as forming a deposit about three miles northeast of Otay. This white to reddish soapy material is classed as a 'rock soap.'

263. ALLOPHANE.

Hydrous silicate of aluminium, $Al_2SiO_5.5H_2O$.

Amorphous. Incrustations. Colorless, pale sky-blue, green, brown. Vitreous luster. H=3; G=1.85 — 1.89.

Refractive index: $n=1.49$.

Infusible. Soluble in hydrochloric acid, yielding gelatinous silica. Heated with cobalt nitrate assumes a blue color.

This is a rare amorphous mineral occurring as an incrustation.

San Luis Obispo County: A specimen has come from Arroyo Grande.

264. RECTORITE.

Hydrous silicate of aluminium, $Al_2O_3.2SiO_2.H_2O$.

Monoclinic. In leaves like mountain leather. Soft with soapy feel. Color white. Pearly luster.

Like kaolinite in its reactions.

This mineral exists as white, pearly scales with a greasy feel. It is a rare mineral.

Amador County: Found in pearly scales near Ione by Turner[1] and analysed by Hillebrand.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	K_2O	Na_2O	H_2O at 100°	H_2O ab. 100°	
55.88	0.50	30.24	0.45	0.16	tr.	0.42	0.34	0.63	11.72	=100.31%

Calaveras County: A mineral similar in appearance has been found in the gangue of the mines at Angels and elsewhere in the Mother Lode.

265. CIMOLITE.

Hydrous silicate of aluminium, $2Al_2O_3.9SiO_2.6H_2O$.

Amorphous. Clay-like or chalky. Color white, grayish or reddish. Soft. G = 2.18 — 2.30.

Refractive index: $n = 1.564$.

Another clay-like substance not distinguishable from kaolin by the blowpipe.

An amorphous clay-like or chalky mineral of rare occurrence.

Lake County: Found in the Uncle Sam quicksilver mine, near Clear Lake.

266. THAUMASITE.

Hydrous silicate, carbonate and sulphate of calcium, $CaSiO_3.CaCO_3.CaSO_4$.

Tetragonal? Masses of interlaced needles. Colorless and white. Greasy luster. H = 3.5; G = 1.877.

Refractive indices: $\epsilon = 1.468$; $\omega = 1.507$.

Infusible, but swells up when heated, coloring the flame red. Easily soluble. Gives water in closed tube.

This is a rare and interesting mineral containing three acid radicals.

Riverside County: Occurs in needles lining cavities of the rock in the limestone at Crestmore. Associated with spurrite. Observed, described and analysed by Foshag[2]. Analysis:

SiO_2	$Al_2O_3.Fe_2O_3$	CaO	SO_3	$H_2O.CO_2$	
9.10	0.84	12.98	27.56	49.48	= 99.96%

267. CHRYSOCOLLA.

Hydrous silicate of copper. $CuSiO_3.2H_2O$.

Cryptocrystalline. Opal-like, earthy, incrustations. Color bluish green, turquois-blue. Vitreous to dull luster. H = 2 — 4; G = 2 — 2.24.

Refractive indices: $\epsilon = 1.57$; $\omega = 1.46$.

Infusible, but soluble in nitric acid without forming a jelly. A blue solution is obtained by adding ammonia to the nitric acid solution. Can be reduced to metallic copper by fusing on charcoal with sodium carbonate. Darkens and gives water in a closed tube.

Small amounts of chrysocolla occur in most of the copper districts of the State, but there are no deposits of the silicate. It occurs as an oxidation product of copper minerals, and is usually a stain or incrustation.

Amador County: Common at Volcano.

Calaveras County: Common as a staining material at Campo Seco and at Copperopolis.

Fresno County: Found at the Ne Plus Ultra mine. Occurs as an alteration of copper minerals at the Gordon Fresno Copper mine and at the Red Streak mine, Big Dry Creek.

Inyo County: Common at the Cerro Gordo mines. Occurs pseudomorph after limonite at the Aries mine. As an alteration of chalcopyrite in the Gold Belt of Panamint Range. Associated with brochantite near headwaters of Cottonwood Creek; with garnet at the Green Monster mine, 1½ miles north of Citrus. Occurs as an alteration of chalcopyrite in garnet rock in Mazourka Canyon. Associated with the scheelite of Deep Canyon, west of Bishop. Occurs with cerargyrite at the Bonanza King mine, Sherman district; at different points on Ubehebe Mountains. Associated with azurite, cuprite, malachite and melaconite at mines of Greenwater district, Black Mountains.

Los Angeles County: Reported from the old Kelsey mine, near San Gabriel Canyon, by Storms[1].

Mariposa County: In streaks near Mariposa.

Mendocino County: Found in the Red Mountain mining district.

Modoc County: Occurs with malachite and cuprite near Fort Bidwell.

Mono County: Common at Lundy and Benton districts. With partzite at the Diana mine, Blind Springs district.

Nevada County: Common with the copper of Meadow Valley and also at Spenceville.

Plumas County: Banded masses with malachite occur at the Engels mine, Light's Canyon, and in the Mohawk Valley. Fine specimens of chrysocolla and malachite are found at the Engels mine.

Riverside County: Has been found in the mines of Chuckawalla Mountains. Good specimens have come from the Mountain King mine.

San Benito County: Small amounts occur with chalcocite in natrolite at the benitoite locality, Louderback[2].

San Bernardino County: Common in the Calico and Bismark districts, Lindgren[4]. Massive at the Copper World mine, Clarke Mountain.

San Diego County: Common in the Julian and Banner districts. Good specimens have come from various places in the county.

Santa Clara County: Occurs with malachite near Fifteen Mile House.

Siskiyou County: Found at the Blue Ledge mine.

268. CHLOROPAL.

Hydrous silicate of iron, $H_6Fe_2Si_3O_{12}.2H_2O$.

Compact massive, opal-like. Color pistachio-green, greenish yellow. Dull luster. H=2.5—4.5; G=1.72—2.01.

Refractive indices: $\alpha=1.625$; $\gamma=1.655$.

Heated intensely, becomes magnetic. Soluble with precipitation of silica. Gives water in a closed tube.

Chloropal is a green, opal-like mineral of rare occurrence.

Nontronite is a yellowish variety.

El Dorado County: Nontronite was observed at Georgetown altered to limonite.

Kern County: Specimens of chloropal have come from the mountains east of Bakersfield.

Mariposa County: Nontronite has been found with garnet in this county.

Placer County: Specimens of chloropal have come from Bath.

269. BEMENTITE

Hydrous silicate of manganese, $2MnSiO_3.H_2O$.

Orthorhombic. Fine fibrous masses and granular. Color pale grayish yellow to light brown. Luster vitreous to pearly. H=3; G=2.98.

Refractive indices: $\alpha=1.624$; $\beta=1.647$; $\gamma=1.647$.

Fuses easily to a dark brown glass. Soluble in hydrochloric acid without gelatinization. Gives green bead of manganese with sodium carbonate.

This is considered a rare mineral, but it appears to be abundant in some of the psilomelane deposits of the State. It is characteristically associated with rose-red inesite and brown neotocite.

Alameda County: Occurs in the Arroyo Mocho manganese ore and observed at the Bailey mine in association with inesite and gray rhodochrosite.

Humboldt County: Associated with brown neotocite and rhodochrosite at the Woods mine, 12 miles northwest of Blocksburg.

Mendocino County: Granular pale brown bementite occurs with neotocite and psilomelane at the Thomas mine, six miles northeast of Redwood. Also at the Mt. Sanhedrin deposits, especially in the Rhodochrosite Claim at Impassable Rock, associated with inesite and neotocite.

San Joaquin County: Masses of it occur at the old Ladd manganese mine.

Stanislaus County: First observed and identified by Foshag in the ore from the Cummings Lease, where it occurs granular, mixed with gray carbonate and rose-red inesite.

270. NEOTOCITE—Stratopeite.

Hydrous silicate of manganese and iron.

Amorphous. Color black to dark brown. Dull luster. H=3—4; G=2.64.

Refractive index: $n=1.47$.

Gives green bead of manganese when fused with sodium carbonate. Soluble in acid. Yields water in a closed tube.

This amorphous silicate of manganese and iron appears to be common in association with the manganese deposits of the State.

Humboldt County: Very abundant in resinous brown to almost black masses at the Woods mine, twelve miles northwest of Blocksburg.

Lake County: Associated with psilomelane at the Witter Springs mine.

Mendocino County: Abundant in the Thomas mine in light and dark brown colors. Also in the deposits of Mt. Sanhedrin.

Sonoma County: A dark brown amorphous mineral with dull luster, supposed to be stratopeite has come from this county.

271. PILOLITE.

Hydrous silicate of calcium and aluminium.

Found in felt-like masses resembling mountain leather and asbestos. G=2.26.

Fusible but insoluble. Gives water in a closed tube.

Santa Clara County: Found on quartz at New Almaden. Also in sheets with dolomite at the Senator mine.

Yuba County: Occurs at Smartsville.

272. SEARLESITE.

Hydrous borosilicate of sodium, $NaB(SiO_3)_2.H_2O$.

Monoclinic. Radiate-fibrous spherulites. Color white. Very soft.

Refractive indices: $\alpha = 1.513$; $\beta = 1.533$; $\gamma = 1.535$.

Easily soluble in hydrochloric acid and somewhat soluble in water. Fuses easily to a clear glass.

This rare salt was described by Larsen and Hicks[1] as a new California mineral.

San Bernardino County: Occurred as crusts of white spherulites at Searles Lake. Analyses and composition determined by Hicks:

SiO_2	B_2O_3	Na_2O	K_2O	MgO	FeO	Al_2O_3	H_2O
56.41	16.26	12.78	1.00	1.82	1.89	0.37	9.47

TITANO-SILICATES.

273. TITANITE—Sphene.

Titano-silicate of calcium, $CaTiSiO_5$.

Monoclinic. Wedge-shaped crystals, sometimes massive. Color brown, yellow, gray, yellowish green. Adamantine luster. H = 5 — 5.5. G = 3.4 — 3.56.

Refractive indices: $\alpha = 1.900$; $\beta = 1.907$; $\gamma = 2.034$.

Slightly soluble in hydrochloric acid and the solution when boiled down with metallic tin, assumes a violet color due to the titanium. Fusible at about 4.

Titanite is a common accessory mineral of the granites, gneisses and schists of the State. It has been mentioned by most writers in their petrographical descriptions as a microscopic constituent of the rocks, and large crystals are seldom found.

Leucoxene is a grayish alteration product of ilmenite, rutile and titanite, often observed in rocks containing those minerals.

Contra Costa County: Titanite is mentioned as an associate of crossite in the schists near San Pablo, by Palache[2].

El Dorado County: Titanite was first observed by Blake[7] in the granite of Slippery Ford and other places of the Sierras.

Fresno County: Titanite is a constituent of the rocks at Fine Gold Gulch.

Inyo County: Occurs at the scheelite deposit of Deep Canyon west of Bishop, in microscopic crystals.

Marin County: Occurs as one of the minerals of the lawsonite schists of the Tiburon Peninsular, Ransome[2].

Plumas County: Leucoxene is mentioned by Murgoci[1] in the syenite of Spanish Peak. A constituent of the norites at Engels.

Riverside County: Granular titanite is rather abundant in the quartz monzonite at Crestmore, in pale brown grains. Small crystals occur in the igneous rocks of Eagle Mountains.

San Diego County: Titanite is an associate of dumortierite at Dehesa, Schaller[5].

San Francisco County: A constituent of the rocks of San Francisco, Lawson[2].

Santa Clara County: Fine large crystals occur in the eclogites of Calaveras Valley, in the quartzite and diorite of Oak Hill, near San Jose, and it is a common constituent of the glaucophane rocks of the Coastal region, Murgoci[1].

Trinity County: Associated with epidote, colorless garnet and zircon in a soda granite-porphyry in the Iron Mountain district.

274. BENITOITE.

Titano-silicate of barium, $BaTiSi_3O_6$.

Hexagonal, rhombohedral. Prisms with trigonal pyramids. Colorless to deep blue. Vitreous luster. Transparent, strongly dichroic. H=6.5; G=3.64 — 3.65.

Refractive indices: $_{\epsilon}$=1.804; $_{\omega}$=1.757.

Soluble sufficiently to give the titanium reaction when the hydrochloric acid solution is boiled with tin. Gives the green flame of barium.

San Benito County: Colorless and beautiful sapphire-blue crystals of this new gem mineral were discovered in 1907 near the headwaters of the San Benito River, about twenty-five miles north of Coalinga and the mineral was described by Louderback[1],[2]. They show the forms: (0001), (10$\bar{1}$0), (10$\bar{1}$1), (01$\bar{1}$1), (11$\bar{2}$0), (10$\bar{1}$2), (22$\bar{4}$1), and are of trigonal habit. The crystals occur in a zone of narrow veins of natrolite in serpentine and have associated with them neptunite, chalcocite, chrysocolla, actinolite, crossite, albite, aegyrite, calcite, aragonite and psilomelane. Analyses of the mineral were made by W. C. Blasdale:

SiO_2	TiO_2	BaO		
43.56	20.18	36.34	=100.08%	
				Sp. G.=3.64 — 3.67
43.79	20.00	36.31	=100.10	

Additional notes on benitoite have been made by Baumhauer[2], Hlawatsch[1], Palache[4] and Rogers[2].

275. NEPTUNITE.

Titano-silicate of iron, manganese, potassium and sodium $(Na,K)_2(Fe,Mn)TiSi_4O_{12}$.

Monoclinic. Prismatic crystals. Color black, in thin splinters blood-red. Streak cinnamon-brown. Vitreous luster. H=5—6; G=3.234.

Refractive indices: $\alpha=1.690$; $\beta=1.699$; $\gamma=1.736$.

Soluble in hydrochloric acid and solution turns violet when boiled with metallic tin. Fused with sodium carbonate, gives green bead of manganese.

San Benito County: Black crystals of neptunite accompany benitoite and these were first described by Louderback[1][2]. The crystals are deep blood-red in thin splinters and show the forms: (001), (100), (110), (111), $(\bar{1}11)$, $(\bar{1}12)$, $(\bar{2}11)$, $(\bar{2}21)$, $(\bar{3}11)$.

An analysis was made by Blasdale:

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	
53.44	17.18	11.23	1.78	0.25	1.82	5.39	9.14	=100.23%

The mineral was later analysed by Bradley[1]:

SiO_2	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	
52.91	17.77	11.54	0.82	1.59	1.41	5.11	9.83	=100.98%
52.83	17.89	11.83	0.88	1.53	1.48	5.06	9.28	=100.78

Further notes on neptunite by Ford[2] and Schaller[10].

CHAPTER X.

PHOSPHATES, CHROMATES, VANADATES, ARSENATES, ANTIMONATES, NITRATES, BORATES, NIOBATES-TANTALATES, TUNGSTATES, MOLYBDATES AND URANATES.

Phosphates.
- Monazite
- Triphylite
- Lithiophilite
- Triplite
- Apatite
- Pyromorphite
- Amblygonite
- Lazulite
- Vivianite
- Purpurite
- Turquois
- Variscite
- Plumbogummite
- Anapaite
- Torbernite
- Autunite
- Hurcaulite
- Palaite
- Stewartite
- Salmonsite
- Strengite
- Sicklerite
- Wilkeite

Chromates.
- Crocoite

Vanadates.
- Pucherite
- Vanadinite
- Descloizite
- Volborthite

Arsenates.
- Mimetite
- Erythrite
- Annabergite
- Scorodite
- Liroconite
- Pitticite

Antimonates.
- Bindheimite

Nitrates.
- Soda niter
- Niter
- Nitrocalcite
- Darapskite
- Nitroglauberite

Borates.
- Ludwigite
- Vonsenite
- Borax
- Colemanite
- Priceite
- Meyerhofferite
- Inyoite
- Ulexite
- Hydroboracite
- Bakerite
- Howlite

Niobates-tantalates.
- Pyrochlore
- Microlite
- Columbite
- Stibiotantalite

Tungstates.
- Hübnerite
- Wolframite
- Scheelite
- Cuproscheelite

Molybdates.
- Wulfenite
- Powellite

Uranates.
- Uraninite
- Uraconite

PHOSPHATES.

The only phosphate of commercial importance as a source of phosphoric acid is the lime phosphate, represented by apatite and lime phosphate rock, deposits of which have not been found in the State. Masses of amblygonite occur, which have been mined for lithia, and veins and seams of turquois are mined for the gem, but the rest of the phosphates are very rare in the State.

276. MONAZITE.

Phosphate of cerium, lanthanum and didymium $(Ce,La,Di)PO_4$.

Monoclinic. Crystals rare. Commonly in grains as sand. Color yellowish brown, sometimes reddish. Vitreous to resinous luster. H = 5 — 5.5; G = 5.0.

Refractive indices: $\alpha = 1.786$; $\beta = 1.788$; $\gamma = 1.837$.

Insoluble and infusible. Fused with sodium carbonate and the fusion dissolved in nitric acid, the solution will give a lemon-yellow precipitate on the addition of ammonium molybdate. Decomposed by concentrated sulphuric acid and the solution treated with ammonium oxalate, will precipitate the rare earth metals (cerium, lanthanum, etc.).

Monazite has been detected in the black sands and concentrates from some of the mines but no deposits of this important mineral are known

in the State. Its presence in the sands has been noted by Day and Richards[1].

Butte County: Traces of monazite have been found in the black sands of Little Rock Creek.

Del Norte County: Observed in the sands at Crescent City and on Gilbert Creek.

El Dorado County: Traces have been found in the concentrates of the Brownsville district and at Placerville.

Humboldt County: Observed at Trinidad.

Placer County: Traces at Michigan Bluff.

Plumas County: Occurs in the sand at Nelson Point.

Yuba County: Traces in the Brownsville district.

277. TRIPHYLITE.

Phosphate of lithium and iron, $LiFePO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Color bluish gray, light blue, grayish green. Vitreous luster. H=4.5—5; G=3.42—3.56.

Refractive indices: $\alpha = 1.688$; $\beta = 1.688$; $\gamma = 1.692$.

Easily fusible and soluble. Ammonium molybdate added to a nitric acid solution precipitates yellow ammonium phospho-molybdate. Yields a red lithium flame when fused.

This rare phosphate usually contains manganese and grades into lithiophilite.

San Diego County: Found in the lithia mines at Pala associated with lithiophilite and purpurite, Graton and Schaller[1].

278. LITHIOPHILITE.

Phosphate of lithium and manganese, $LiMnPO_4$.

Orthorhombic. Commonly massive. Cleavage perfect basal. Color brown, salmon-pink. Vitreous luster. H=4.5—5; G=3.42—3.56.

Refractive indices: $\alpha = 1.676$; $\beta = 1.679$; $\gamma = 1.687$.

Easily fusible and soluble. The phosphate reaction is obtained when ammonium molybdate is added to the nitric acid solution. Fuses with a red flame. The sodium carbonate bead is blue-green.

San Diego County: Found with triphylite and purpurite as an alteration product of triphylite at Pala, Graton and Schaller[1].

279. TRIPLITE.

Phosphate of iron, manganese and fluorine, $3(Mn,Fe)O.P_2O_5.MnF_2$.

Monoclinic. Massive. Color pink, brown, to black. Streak yellowish brown. H=4—5.5; G=3.44—3.8.

Refractive indices: $\alpha=1.665$; $\beta=1.673$; $\gamma=1.682$.

Fuses easily to a black magnetic globule. With borax it gives an amethystine bead and with sodium carbonate a green bead. Soluble in hydrochloric acid. Usually gives a fluorine test when dissolved with sulphuric acid.

A rare mineral usually occurring with tungsten minerals in pegmatite veins.

San Bernardino County: Found with hübnerite on specimens from a deposit eight or ten miles north of Goffs, Hess[6].

280. APATITE.

Phosphate of calcium with chlorine or fluorine $(CaCl)Ca_4(PO_4)_3$ or $(CaF)Ca_4(PO_4)_3$.

Hexagonal. Prismatic crystals, granular, massive. Color brown, green, yellow, pink, colorless. Vitreous to greasy luster. H=5; G=3.17—3.23.

Refractive indices: $\epsilon=1.631$; $\omega=1.634$.

Practically infusible, but easily soluble. Ammonium molybdate precipitates much canary-yellow granular powder. Calcium can be determined by dissolving in hydrochloric acid, adding ammonia to precipitate the calcium phosphate, redissolving this precipitate with just enough drops of acid, and then adding ammonium oxalate, which will precipitate the calcium. Some varieties will give a fluorine reaction.

Apatite has been observed as small crystals in many of the rocks of the State, but no deposits of the mineral are known. A small percentage of calcium phosphate is found in many of the limestones of the State.

Contra Costa County: Found in brownish masses in the schists north of Berkeley.

Fresno County: Observed in the rocks near Dunlap.

Humboldt County: Specimens of rock phosphate or phosphorite have been found near Yager.

Placer County: An earthy lime phosphate has been found near Dutch Flat.

Plumas County: A constituent of the syenite of Spanish Peak, Murgoci[1]. Occurs as a constituent of the norites at Engels copper mine.

Riverside County: Greenish blue apatite as granular masses occur in white calcite, associated with diopside and wollastonite, at Crestmore.

San Bernardino County: Small crystals were found in limestone on eastern end of Kingston Range.

San Diego County: Occurs in the gneiss at Dehesa with dumortierite, Schaller[5]. Tabular crystals of violet and pink colors occur at the old Mack mine near Rincon. At the Victor mine, Rincon, pale dirty green crystals occur with the forms: (0001), (10$\bar{1}$0), (11$\bar{2}$1), (10$\bar{1}$2), (10$\bar{1}$1), (31$\bar{4}$1), Rogers[3]. Crystals are also found on South Mountain and at Mesa Grande. Small crystals occur in limestone near Jacumba, and near Grapevine Camp.

San Francisco County: Mentioned by Lawson[2] in the rocks of San Francisco.

281. PYROMORPHITE.

Phosphate of lead with chlorine $(PbCl)Pb_4(PO_4)_3$.

Hexagonal. Prismatic crystals, columnar, massive. Color brown, yellowish green. Adamantine luster. H = 3.5 — 4; G = 6.5 — 7.1.

Refractive indices: $\epsilon = 2.042$; $\omega = 2.050$.

Fuses easily on charcoal and yields a lemon-yellow coating when reduced. The phosphate reaction can be obtained by dissolving in nitric acid and adding ammonium molybdate.

The lead phosphate is occasionally found in the mining districts as an oxidation product of galena and a few localities are known.

Calaveras County: Green crystals in gold quartz have been found at the Reliance mine.

El Dorado County: Occurred at Mosquito Gulch, six miles northeast of Placerville as a yellowish green coloring matter in botryoidal chalcedony and as a crystalline coating, Turner[8].

Inyo County: Found in small amounts in the Cerro Gordo district.

Mariposa County: A small amount was found in the mines near Coulterville.

Riverside County: Found at the El Dorado mine in crystals at 300-foot level.

Tulare County: Found in the White Chief mine, Mineral King district, Goodyear[1].

282. AMBLYGONITE.

Phosphate of lithium and aluminium with fluorine, $Li(AlF)PO_4$.

Triclinic. Generally massive. Cleavage perfect basal. Color white. Pearly to vitreous luster. H = 6; G = 3.10.

Refractive indices: $\alpha = 1.579$; $\beta = 1.593$; $\gamma = 1.597$.

Insoluble, but easily fusible, giving the red flame of lithium. Fused with sodium carbonate and then boiled with nitric acid, the phosphate reaction is obtained on the addition of ammonium molybdate to the solution.

This is an important lithia mineral, and but one deposit is known in the State.

San Diego County: A large mass of white massive amblygonite occurs in the pegmatite vein carrying the rubellite and lepidolite and was mined at the Stewart mine, Pala. The mineral was analysed by Schaller[3].

P_2O_5	Al_2O_3	Fe_2O_3	MnO	MgO	Li_2O	Na_2O	H_2O	
48.83	33.70	0.12	0.09	0.31	9.88	0.14	5.95	
			F	TiO_2		O		
			2.29	none	=101.31 — 0.96			=100.35%

Massive amblygonite occurs on Aguanga Mountains associated with blue tourmaline and cassiterite.

A few small specimens of white cleavable amblygonite have been found at the Victor mine, Rincon, Rogers[3].

283. LAZULITE.

Basic phosphate of aluminium, iron and magnesium $(Fe,Mg)Al_2(OH)_2P_2O_8$.

Monoclinic. Sharp pointed pyramids, granular. Color azure-blue. Vitreous luster. H=5 — 6; G=3.05.

Refractive indices: $\alpha=1.603$; $\beta=1.632$; $\gamma=1.639$.

Infusible and insoluble. Falls to pieces when heated. Fused with sodium carbonate and then dissolved in nitric acid, the phosphate reaction is obtained by adding ammonium molybdate. Yields water in a closed tube.

Lazulite is a rare phosphate found in quartzites and metamorphic rocks.

Inyo County: Lazulite occurs in a white quartz vein intersecting schist in Breyfogle Canyon, Death Valley. Occurs in a vein cutting schist, in pale to deep azure blue colors in Breyfogle Canyon, Death Valley.

Los Angeles County: Specimens have been found in the San Gabriel Mountains.

Mono County: Blue lazulite occurs as bands in a white quartzite associated with rutile, near Mono Lake. Occurs associated with coarse granular andalusite in the White Mountains near the southern border of the county, Knopf[5].

Deep blue lazulite was found in a quartz vein in Green Creek Canyon, near Bodie, Rogers[5].

San Diego County: Some lazulite has been reported as found in the rock at Oceanside.

284. WILKEITE.

Phosphate and silico-sulphate of calcium, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4)(SO_4).CaO$.

Hexagonal. Small prismatic crystals and grains. Color pale rose-red. Vitreous luster. H=5; G=3.234.

Refractive indices: $\epsilon=1.650$; $\omega=1.655$.

Infusible, but soluble in nitric acid. The nitric acid solution gives a phosphate reaction on addition of ammonium molybdate and a sulphate reaction on addition of barium chloride.

This very rare mineral is unlike any other in having four acid radicals. It resembles apatite in physical properties.

Riverside County: A recently discovered new mineral in the State, occurring in blue calcite, with diopside, vesuvianite, garnet, and its alteration product, crestmoreite, in the limestone quarry at Crestmore. Analysis by Eakle and Rogers[1].

CaO	MnO	P_2O_5	SO_3	SiO_2	CO_2	H_2O	
54.44	0.77	20.85	12.28	9.63	2.10	tr.	=100.06%

285. VIVIANITE.

Hydrous phosphate of iron, $Fe_3P_2O_8.8H_2O$.

Monoclinic. Long prismatic crystals, earthy, incrustations. Cleavage perfect clinopinacoidal. Color generally sky-blue or green, rarely colorless. Pearly to dull luster. H=1.5 — 2; G=2.58 — 2.68.

Refractive indices: α=1.579; β=1.603; γ=1.633.

Soluble and fusible. Fuses to a black magnetic mass. Ammonium molybdate added to a nitric acid solution gives the yellow phosphate reaction. Yields water in a closed tube.

The iron phosphate is formed in rocks, usually sedimentary rocks, by decaying phosphatic matter such as bones, in the presence of iron.

Alameda County: Small specimens of earthy blue vivianite were found some years ago in the hills back of Berkeley and were reported by Hanks[6].

Calaveras County: Has been found at Copperopolis.

Humboldt County: Occurs in the rock at Yager. Said to have been found on Maple Creek.

Los Angeles County: Early observed as earthy blue masses in the asphalt bed of the Rancho de la Brea, where it formed by the decomposition of the bones of extinct animals. Mentioned by W. P. Blake[15].

Madera County: Dark blue earthy masses have been found near Raymond.

Yuba County: Good crystals occurred near Camptonville and were described by Jackson[3]. They showed the forms: (010), (100), (110), (111), (101), (411), (410).

286. PURPURITE.

Hydrous phosphate of manganese and iron $(Fe,Mn)_2O_3.P_2O_5.H_2O$.

Orthorhombic. Irregular masses. Color deep red or purple. Satin luster. H=4 — 4.5; G=3.40.

Refractive index: β=1.86.

Similar to vivianite in reactions. Yields a blue-green bead of manganese with sodium carbonate.

One of the very rare minerals associated with the pegmatites of San Diego County. Of a deep red or purple color.

San Diego County: Found at Pala in a pegmatitic dike on Hiriart Hill, associated with lithiophilite and triphylite, Graton and Schaller[1].

287. TURQUOIS.

Hydrous phosphate of aluminium, $AlPO_4.Al(OH)_3.H_2O$.

Massive. In thin seams and incrustations. Color sky-blue, bluish green, apple-green. Waxy luster. H=6; G=2.6—2.83.

Refractive indices: $\alpha=1.61$; $\beta=1.62$; $\gamma=1.65$.

Soluble in hydrochloric acid. Infusible and becomes brown or black when heated. May give reaction for copper. After fusion with sodium carbonate and dissolving in nitric acid, the phosphate reaction is obtained on addition of ammonium molybdate to solution. Gives water in a closed tube.

Thin seams of apple-green and bluish green turquois occur in the State which are suitable for gem purposes when cut with the matrix.

Madera County: A specimen of turquois (Kallaite) was found on the Taylor ranch, having a hexagonal form and it was described as a pseudomorph after apatite, Moore and Zepharovitch[1].

San Bernardino County: Some apple-green turquois has been found near Victor. Turquois was early mined from a deposit in the extreme northeastern part of the county in the high mountains north of Ivanpah. Considerable light green gem material has been obtained from this district. Occurs near the head of Riggs Wash, twelve miles northeast of Silver Lake, in a coarse porphyritic granite and in porphyry dikes. Some turquois has been found in the Solo mining district, thirty miles northwest of Cima.

Tulare County: Specimens of turquois have come from this county, a few miles from the Kern county line.

288. VARISCITE.

Hydrous phosphate of aluminium, $AlPO_4.2H_2O$.

Orthorhombic. Usually in round compact masses. Color deep emerald-green or bluish green. Vitreous luster. H=4; G=2.54.

Refractive indices: $\alpha=1.551$; $\beta=1.558$; $\gamma=1.582$.

Infusible, but whitens when heated. Moistened with cobalt solution and intensely heated, it becomes blue. Gives water in a closed tube. Phosphate can be precipitated by ammonium molybdate from a nitric acid solution after fusion of the powder with sodium carbonate.

El Dorado County: Specimens have come from Pleasant Valley.

289. PLUMBOGUMMITE.

Hydrous phosphate of lead and aluminium, $PbO.2Al_2O_3.P_2O_5.H_2O$.

Hexagonal. Globular, incrustations, compact massive. Color reddish brown, yellowish gray. Resinous luster. H=4—5; G=4—4.9.

Refractive indices: $\epsilon=1.676$; $\omega=1.654$.

Fused on charcoal with sodium carbonate, a yellow coating and metallic globule of lead are obtained. The nitric acid solution gives the phosphate reaction on adding ammonium molybdate. Yields water in a closed tube.

Inyo County: A specimen of this rare mineral has been found at the Cerro Gordo mine.

290. ANAPAITE.

Hydrous phosphate of calcium and iron, $(Ca.Fe)_3PO_4.4H_2O$.

Triclinic. Usually in tabular crystals. Color pale green. Vitreous. H=3.5; G=2.81—2.85.

Refractive indices: $\alpha=1.602$; $\beta=1.613$; $\gamma=1.649$.

Soluble in nitric acid and a yellow precipitate is obtained by adding ammonium molybdate to the acid solution. Becomes magnetic on heating. Gives water in a closed tube.

Kings County: This rare phosphate was found in the Lewis well, Sec. 23, T. 21 S., R. 21 E., at a depth of 500 feet, in layers of pale green crystals.

291. TORBERNITE.

Hydrous phosphate of uranium and copper. $CuO.2UO_3.P_2O_5.8H_2O$.

Tetragonal. Usually in square flakes and micaceous. Perfect basal cleavage. Color emerald-green. Streak pale green. H=2—2.5; G=3.4—3.6.

Refractive indices: $\epsilon=1.582$; $\omega=1.592$.

Uranium minerals are very rare in the State.

San Bernardino County: Specimens of green torbernite with yellow autunite have come from the northeastern part of the county.

292. AUTUNITE.

Hydrous phosphate of uranium and calcium. $CaO.2UO_3.P_2O_5.8H_2O$.

Orthorhombic. Thin tabular crystals. Color lemon-yellow. Streak yellow. Cleavage perfect basal. H=2—2.5; G=3.19.

Refractive indices: $\alpha=1.553$; $\beta=1.575$; $\gamma=1.577$.

Fuses easily to black mass giving a pale greenish flame. Gives green bead with phosphorous salt. Soluble in nitric acid.

San Bernardino County: Specimens of yellow autunite associated with green plates of torbernite have come from the northeastern part of the county.

293. HUREAULITE.

Hydrous phosphate of manganese, $5MnO.2P_2O_5.5H_2O$.

Monoclinic. Groups of short prisms. Also scaly, massive. Color orange-red, rose and nearly colorless. H=5; G=3.185.

Refractive indices: $\alpha=1.647$; $\beta=1.654$; $\gamma=1.660$.

Fusible and soluble. The nitric acid solution gives the phosphate reaction on addition of ammonium molybdate. A blue-green bead of manganese is obtained when fused with sodium carbonate. Yields water in a closed tube.

San Diego County: Found in the Stewart mine at Pala and mentioned by Schaller[14].

294. PALAITE.

Hydrous phosphate of manganese, $5MnO.2P_2O_5.4H_2O$.

Monoclinic? Crystalline masses. Color flesh-red. G=3.14 — 3.20.

Refractive indices: $\alpha=1.652$; $\beta=1.656$; $\gamma=1.660$.

Reactions are similar to those for hureaulite.

San Diego County: A new phosphate of manganese having a flesh-red color, which has resulted from the alteration of lithiophilite. Found in the Stewart mine at Pala and described and analysed by Schaller[14]. Analysis:

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O	Li_2O	Insol.	
7.48	40.87	1.77	0.16	39.02	10.43	tr.	0.89	=100.62%

295. STEWARTITE.

Hydrous phosphate of manganese.

Triclinic? Minute crystals. G=2.94.

Refractive indices: $\alpha=1.63$; $\beta=1.66$; $\gamma=1.69$.

Reacts similar to hureaulite.

San Diego County: Found in the Stewart mine at Pala as an abundant alteration product of lithiophilite. Finely fibrous doubly refracting mineral, probably triclinic. Described by Schaller[14].

296. SALMONSITE.

Hydrous phosphate of manganese and iron, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.

Massive. Color buff-yellow. G=2.88.

Refractive indices: $\alpha=1.655$; $\beta=1.66$; $\gamma=1.670$.

Reacts similar to vivianite, but gives in addition a blue-green bead of manganese with sodium carbonate.

San Diego County: A new mineral resulting from the alteration of hureaulite, having a buff-yellow color, occurring in the Stewart mine associated with fibrous palaite and blue strengite. Described and analysed by Schaller[14]. Analysis:

FeO	MnO	CaO	Fe_2O_3	P_2O_5	H_2O	Insol.	
0.13	37.74	1.06	9.53	34.86	15.73	1.40	=100.45%

297. STRENGITE.

Hydrous phosphate of iron. $Fe_2O_3.P_2O_5.4H_2O$.

Orthorhombic. Generally in spherical and botryoidal forms. Color pale red. Vitreous luster. H=3 — 4; G=2.87.

Refractive indices: $\alpha=1.708$; $\beta=1.708$; $\gamma=1.745$.

Reacts similar to vivianite.

San Diego County: Found in the Stewart mine at Pala associated with salmonsite, Schaller[14].

298. SICKLERITE.

Hydrous phosphate of iron, manganese and lithia, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.

Massive. Color dark brown. Streak light yellowish brown. G=3.45.

Refractive indices: $\alpha=1.715$; $\beta=1.735$; $\gamma=1.745$.

Reacts like lithiophilite.

San Diego County: Occurs in cleavable masses at the Vanderburg-Naylor mine on Hiriart Hill, near Pala. Dark brown mineral resulting from the alteration of lithiophilite. Described and analysed by Schaller[14]. Analysis:

MnO	CaO	Fe_2O_3	Mn_2O_3	P_2O_5	H_2O	Li_2O	Insol.	
33.60	0.20	11.26	2.10	43.10	1.71	3.80	4.18	=99.95%

CHROMATE.

299. CROCOITE.

Chromate of lead, $PbCrO_4$.

Monoclinic. Long prismatic crystals or granular. Sectile. H=2.5—3; G=5.9—6.1. Adamantine luster. Color bright red. Streak orange-yellow.

Refractive indices: $\alpha=2.31$; $\beta=2.37$; $\gamma=2.66$.

A rare mineral in this State.

Inyo County: Found in the Darwin mines associated with wulfenite.
Riverside County: Occurred in the El Dorado mine, near Indio.

VANADATES.

The minerals containing vanadium are exceedingly rare and are only represented by a few localities.

300. PUCHERITE.

Vanadate of bismuth, $BiVO_4$.

Orthorhombic. Tabular and acicular crystals. Perfect basal cleavage. Color reddish brown. Streak yellow. H=4; G=6.25.

Refractive indices: $\alpha=2.41$; $\beta=2.50$; $\gamma=2.51$.

Fused on charcoal with mixture of potassium iodide and sulphur, a red sublimate is obtained mixed with greenish yellow. The phosphorous salt bead of vanadium is yellow in oxidizing flame and emerald-green in reducing flame.

San Diego County: The yellow bismuth ocher which occurs at the Pala Chief mine, near Pala, has been determined by Schaller[9] to be pucherite with the following composition:

			H_2O			
Bi_2O_3	V_2O_5	Insol.	at 107°	at 240°	Ign.	
66.14	25.80	7.37	0.21	0.32	0.84	=100.68%

301. VANADINITE.

Vanadate of lead with chlorine $(PbCl)Pb_4(VO_4)_3$.

Hexagonal. Small prisms. Color deep ruby-red, sometimes yellow. Somewhat resinous luster. H=3; G=6.66—7.23.

Refractive indices: ϵ=2.299; ω=2.354.

Fused on charcoal with sodium carbonate, the mineral is reduced to metallic lead with a yellow sublimate on the coal. The green bead of vanadium can be obtained with phosphorous salt. Dissolved in nitric acid and a drop of silver nitrate added to the solution, silver chloride will be precipitated.

Kern County: Some crystallized vanadinite has been found two miles north of Searles Lake. Associated with galena and mimetite near Randsburg.

San Bernardino County: This rare lead mineral occurs at Camp Signal, near Goffs, in the Vanadium King mine, associated with cerussite and cuprodescloizite, Schaller[12]. Some has been found near Moore Station on Salt Lake Railroad.

302. DESCLOIZITE—Cuprodescloizite.

Vanadate of lead, zinc and copper.

Orthorhombic. Drusy surfaces and crusts. Color yellowish brown, dull green and greenish black. H=3.5; G=6.2.

Refractive indices: α=2.18; β=2.26; γ=2.35.

Blowpipe reactions are similar to those for vanadinite. Ammonia added to a nitric acid solution may show blue solution of copper. Reaction can also be obtained for zinc by heating coating on charcoal with cobalt nitrate. Gives a small amount of water in a closed tube.

San Bernardino County: Minute colorless and yellowish plates of the rare cuprodescloizite occur with cerussite and vanadinite at Camp Signal, Schaller[12].

303. VOLBORTHITE.

Hydrous vanadate of copper, barium and calcium.

Small plates in globular aggregations. Color olive-green, citron-yellow. Streak yellowish green. Pearly to vitreous luster. H=3—3.5; G=3.5.

Refractive indices: α=2.09; β=2.01; γ=2.02.

A small amount of metallic copper can be obtained by reduction on charcoal, using sodium carbonate flux. Ammonia added to a nitric acid solution will show the blue color of copper. Dilute sulphuric acid added to solution will precipitate barium-sulphate. The green bead of vanadium can be obtained with phosphorous salt. Water is given off in a closed tube.

Glenn County: Reported to have been found at the Mammoth Copper mine on Grindstone Creek.

ARSENATES.

The arsenates and antimonates are generally the result of the direct oxidation and hydration of arsenides and the sulphosalts of arsenic and antimony. They are usually found as coatings upon the mineral from which they are derived.

304. MIMETITE.

Arsenate of lead with chlorine $(PbCl)Pb_4(AsO_4)_3$.

Hexagonal. Prismatic crystals, rounded or globular aggregations. Color pale yellow, light brown. Resinous luster. H = 3.5; G = 7 — 7.25.

Refractive indices: $_{\epsilon}$ = 2.118; $_{\omega}$ = 2.135.

Reduced on charcoal to metallic lead and gives a yellow coating, using sodium carbonate as flux. Powder heated in closed tube with a splinter of charcoal above it, becomes reduced to metallic arsenic, which forms a ring around the walls of the glass. Gives a slight chlorine reaction with nitric acid and silver nitrate.

Brown crystals of mimetite are often associated with pyromorphite, and the two minerals are very closely allied in properties and occurrences.

Inyo County: One of the numerous minerals occurring in the Cerro Gordo mines.

Kern County: Found associated with galena near Randsburg.

San Bernardino County: Small amounts of the mineral were found in the Morning Star mine, Lava Beds district. Brown mimetite associated with galena, wulfenite and malachite about eighty miles north of Barstow.

305. ERYTHRITE—Cobalt Bloom.

Hydrous arsenate of cobalt, $Co_3As_2O_8.8H_2O$.

Monoclinic. Fibrous, incrustations, earthy. Cleavage perfect clinopinacoidal. Color peach-blossom red. Pearly to adamantine luster. H = 1.5 — 2.5; G = 2.95.

Refractive indices: α = 1.626; β = 1.661; γ = 1.699.

Gives a white coating of arsenic oxide on charcoal. A little of the well-roasted powder fused in borax bead, gives the fine blue bead of cobalt. Yields water in closed tube.

The peach-blossom red coatings and incrustations of erythrite are seen wherever smaltite or other cobalt minerals exist, and this secondary oxidation product often serves to locate deposits of cobalt.

Los Angeles County: Coatings of erythrite with smaltite, argentite and barite occurred at the old Kelsey and O. K. mines near the San Gabriel Canyon.

Mariposa County: Found in rock seams with danaite, the cobaltiferous arsenopyrite, at the Josephine mine, Bear Valley, Turner[4].

Napa County: Occurs with smaltite in serpentine and chlorite in the Berryessa Valley.

San Diego County: Associated with smaltite in a specimen from near the Mexican line.

306. ANNABERGITE—Nickel Bloom.

Hydrous arsenate of nickel, $Ni_3As_2O_8.8H_2O$.

Monoclinic. Finely fibrous incrustations. Color apple-green. Vitreous luster. Very soft.

Refractive indices: $\alpha = 1.622$; $\beta = 1.652$; $\gamma = 1.687$.

Reacts similarly to erythrite, but the borax bead of nickel is brown in oxidizing flame and gray-cloudy in the reducing flame.

The green coatings of this nickel compound are an indication of the presence of nickel minerals that have been oxidized, and often the cobalt bloom is associated with the nickel bloom.

Lassen County: Reported with erythrite and smaltite from this county.

Los Angeles County: The green coatings of nickel arsenate were associated with erythrite and smaltite at the Kelsey mine, San Gabriel Canyon, Storms[1].

Tulare County: The green color of the chrysoprase and chrysopal in the hills east of Porterville is due to nickel, and some coatings of annabergite occur in the region.

307. SCORODITE.

Hydrous arsenate of iron, $FeAsO_4.2H_2O$.

Orthorhombic. Aggregates of small crystals. Color pale leek-green, liver-brown. H = 3.5 — 4; G = 3.1 — 3.3.

Refractive indices: $\alpha = 1.738$; $\beta = 1.742$; $\gamma = 1.765$.

A slight coating of arsenic can be obtained on charcoal when reduced, and the residue becomes magnetic. The arsenic ring can be obtained by fusing in a closed tube with a splinter of charcoal. Gives water in a closed tube.

Inyo County: In Noonday mine, near Tecopa.

Mariposa County: Pale green crystals of scorodite were found as an alteration product of arsenopyrite associated with pittieite on the South Merced River, near the mouth of Devil's Gulch, Rogers[5].

San Diego County: Near Moreno Lake. Massive.

308. LIROCONITE.

Hydrous arsenate of aluminium and copper.

Monoclinic. Thin tabular crystals. Color sky-blue, green. Streak blue or green. Vitreous luster. H=2 — 2.5; G=2.88 — 2.98.

Refractive indices: $\alpha = 1.612$; $\beta = 1.652$; $\gamma = 1.675$.

Can be reduced to metallic copper on charcoal with sodium carbonate flux, and yields a slight coating of arsenic. Ammonia added to a nitric acid solution will precipitate flocculent alumina hydrate, while the solution becomes blue. Gives water in a closed tube and also an arsenical mirror when vapors are reduced by a splinter of charcoal.

Inyo County: The very rare copper arsenate was found at the old Cerro Gordo mine associated with other rare copper salts.

309. PITTICITE.

Hydrated arsenate and sulphate of iron.

Massive and reniform. Color brown. H=2 — 3; G=2.2 — 2.5.

Refractive index: $n = 1.635$.

Becomes magnetic on heating. Barium chloride added to the hydrochloric acid solution precipitates barium sulphate. Gives water and the arsenic mirror in a closed tube.

Mariposa County: Dark brown amorphous pitticite resembling limonite was found with scorodite as an alteration product of arsenopyrite, on the South Merced River, near the mouth of Devil's Gulch, Rogers[5].

ANTIMONATE.

310. BINDHEIMITE.

Hydrous antimonate of lead, $Pb_3Sb_2O_8.4H_2O$.

Amorphous. Lamellar, massive, incrustations. Color brown, white, gray. Resinous luster. H=4; G=4.6 — 4.76.

Refractive index: $n = 1.84$.

Easily reduced on charcoal to a brittle white metallic globule of antimony and lead, and yields a white and yellow coating of the mixed oxides. A white antimony oxide coating can be obtained in an open tube. Gives water in a closed tube.

Fresno County: Some brown bindheimite has come from this county.

Inyo County: Brown resinous lead antimonate was one of the rare minerals at the Union and Modoc mines, and was mentioned by W. P. Blake[6].

NITRATES.

The nitrates can only exist in solid form in arid regions and are therefore peculiar to desert lands where they are sometimes left as white incrustations by evaporation. Some of these white crusts are to be found in the California desert land, but no important deposits are known.

311. SODA NITER—Chili Saltpeter.

Nitrate of sodium, $NaNO_3$.

Hexagonal, rhombohedral. Crystals, massive, incrustations. Cleavage perfect rhombohedral. Color white, reddish, yellowish. Vitreous luster. H=1.5—2; G=2.24—2.29.

Refractive indices: ϵ=1.536; ω=1.587.

Soluble in water. Fuses with strong yellow flame of sodium. Heated in a bulb tube with potassium bisulphate, gives off red vapors of nitrous oxide.

Inyo County: Crusts of saltpeter occur along the Amargosa River and along shore lines and old beaches of Death Valley, which were reported by Bailey[1].

Merced County: Occurs in crusts with other sodium salts, from Merced Bottom.

San Bernardino County: The same white incrustations extend along the Amargosa River in this county. Small amounts of soda niter have been found in the Calico district, Williams[1], and at Searles Borax Lake.

Tulare County: Alkaline crusts containing soda niter with other soda salts occur in San Joaquin Valley, near Tulare City.

312. NITER—Saltpeter.

Nitrate of potassium, KNO_3.

Orthorhombic. Silky tufts, incrustations. Color white. Vitreous luster. H=2; G=2.09—2.14. Salt taste.

Refractive indices: α=1.334; β=1.505; γ=1.506.

Similar to soda niter in its reactions, but the flame is violet red, best seen through blue glass or the Merwin color screen.

Inyo County: The common saltpeter occurs with the soda niter in the Death Valley region. Crusts of the nitrates of sodium and potassium occur near Shoshone.

Modoc County: Incrustations of potassium nitrate have been found near Cedarville.

Riverside County: Bailey[1] mentions saltpeter as found in the desert northeast of Salton.

San Bernardino County: Occurs with the soda niter in the Amargosa Canyon.

313. NITROCALCITE.

Hydrous nitrate of calcium, $Ca(NO_3)_2.nH_2O$.

Silky tufts and masses. Efflorescent. Color white or gray. Sharp, bitter taste.

Refractive indices: $\alpha = 1.465$; $\beta = 1.498$; $\gamma = 1.500$.

Soluble in water. Fused with potassium sulphate in a bulb tube, it gives off red fumes of nitrous oxide. Heated in a closed tube, it yields water. Ammonia and ammonium oxalate added to a hydrochloric acid solution precipitates white calcium oxalate.

San Bernardino County: The white efflorescent nitrocalcite occurs in the niter beds of the lower end of Death Valley, according to Bailey[1].

314. DARAPSKITE.

Hydrous sulphato-nitrate of sodium, $NaNO_3.Na_2SO_4.H_2O$.

Tetragonal. Square tabular crystals. Colorless.

Refractive indices: $\alpha = 1.391$; $\beta = 1.481$; $\gamma = 1.486$.

Soluble in water. Heated in bulb tube with potassium sulphate, gives red nitrous fumes. Fuses with strong yellow flame. Barium chloride added to acid solution precipitates barium sulphate. Yields water in a closed tube.

San Bernardino County: This rare nitrate occurs in the niter beds of Death Valley according to Bailey[1].

315. NITROGLAUBERITE.

Hydrous sulphato-nitrate of sodium, $6NaNO_3.2Na_2SO_4.3H_2O$.

Fibrous masses. Color white.

Refractive indices: $\alpha = 1.418$; $\beta = 1.500$; $\gamma = 1.543$.

Reactions for the mineral are the same as for darapskite.

Inyo County: Also an efflorescence in the niter beds of Death Valley, according to the report of Bailey[1].

BORATES.

The element boron is widely distributed in the State. It is present in many of the spring waters and lakes and has been an important factor in the formation of much of the igneous rocks of the Sierras. Granites and acid pegmatites containing an abundance of tourmaline are very common. The bedded deposits of lime and soda borates in the southern counties appear inexhaustible. All of the deposits of borates occur in regions which have been the scene of much volcanic activity, and the emanations of the boron gas have accompanied or followed eruptions and intrusions, issuing from vents in the form of hot borated waters. It is perhaps by the action of these waters on the travertine or soda accumulations in lake depressions that the thick bedded deposits of these borate salts have formed.

316. LUDWIGITE.

Borate of magnesium and iron, $3MgO.B_2O_3.FeOFe_2O_3$.

Orthorhombic. Small fibrous masses. Color blackish green. Silky luster. H=5; G=3.91 — 4.02.

Refractive indices: $\alpha=1.85$; $\beta=1.85$; $\gamma=2.02$.

Soluble in hydrochloric and sulphuric acids, but insoluble in nitric acid. Yellow turmeric paper dipped into the hydrochloric acid solution, turns red when dried. Fusible into a magnetic mass. Magnesia can be precipitated by sodium phosphate after the boron and iron have been removed.

El Dorado County: Scaly masses of black ludwigite, associated with calcite, epidote, molybdenite and chalcopyrite occur at the old Cosumnes copper mine, near Fairplay, Rogers[5].

317. VONSENITE.

Borate of iron and magnesium. $2(Fe,Mg)O.B_2O_3+FeO.Fe_2O_3$.

Orthorhombic. Imperfect crystals and granular masses. Color black. Streak brownish black. Brilliant metallic luster. Very brittle. H=5; G=4.21. Perfectly opaque and non-magnetic.

Fuses easily to a black magnetic mass and gives green flame of boron. Soluble in hydrochloric and sulphuric acids, but unattacked by nitric acid.

A new borate apparently derived by the action of borate solutions on magnetite.

Riverside County: Discovered by M. Vonsen in the old city quarry at Riverside and was described and named by Eakle[11]. Forms on the imperfect crystals are: (110), (210), (140) and (160). The analysis gave:

FeO	MgO	B_2O_3	Fe_2O_3
39.75	10.71	14.12	34.82 = 99.40%

318. BORAX—Tincal.

Hydrous borate of sodium, $Na_2B_4O_7.10H_2O$.

Monoclinic. Crystals, powder, incrustations. Colorless, white. Greasy to dull luster. H=2 — 2.5; G=1.69 — 1.72. Sweetish alkaline taste.

Refractive indices: $\alpha=1.447$; $\beta=1.470$; $\gamma=1.472$.

Soluble in water. Fuses with strong yellow flame to a clear glass. Turmeric paper dipped in a hydrochloric acid solution, turns deep red on drying. Gives much water in a closed tube.

The natural borax, usually accompanied by sulphates of lime and soda, is common at many of the depressions or sinks of the deserts. For some time it was the chief mineral, but the more extensive solid masses of colemanite have replaced it as the principal boron mineral.

Tincalconite. A name given to a white effloresent variety by Shepard[2].

Inyo County: The borax industry began with the discovery of the extensive deposits of Death Valley, although some borax had been

previously dredged from Little Borax Lake, in Lake County. The mines on Furnace Creek and at Resting Springs produced large quantities, and it was hauled to Mojave by the famous 20-mule team.

Kern County: Borax is also common at some of the sinks and wells of the desert and has been obtained from Kane Springs and Desert Wells.

Lake County: The first discovery of borax in the State was made at Little Borax Lake, a few miles south of Clear Lake. Fine large crystals were obtained from the mud of the lake bottom, and considerable borax was dredged from this lake before the more important deposits of San Bernardino County were discovered. W. P. Blake[8] and Hanks[5] have described this occurrence.

Riverside County: Incrustations of borax are rather common at some of the playa or dry lakes of this county, but none is produced.

San Bernardino County: The most important deposit of natural borax in the State occurs at Searles Borax Lake in the northern part of the county. Hanks[9] and others have described this deposit. It consists of a pan-like depression about 10 miles long by 5 miles wide and borax occurs with numerous other salts deposited by the evaporated waters of the lake. The associated minerals forming layers in the deposit are mainly sulphates and carbonates of sodium and it is now mainly for these and for the potash associated with them that the deposit is worked. This locality is noted for the great variety of interesting salts that have formed by the evaporation of the waters.

Borax has been found with the colemanite near Yerma and at many of the numerous depressions in the Mojave desert and in the lower end of Death Valley.

319. COLEMANITE.

Hydrous borate of calcium, $Ca_2B_6O_{11}.5H_2O$.

Monoclinic. Crystals, massive. Cleavage perfect clinopinacoidal. Colorless, white, yellowish white. Vitreous luster. H=4—4.5; G=2.42.

Refractive indices: $\alpha=1.586$; $\beta=1.592$; $\gamma=1.614$.

Decrepitates violently when touched with hot flame, but finally fuses to a clear glass. Powder on platinum wire, moistened with sulphuric acid, will give a momentary green flame of boron mixed with reddish flame of calcium. Yields water in a closed tube.

This valuable borate is the principal mineral for borax in the State. It was first discovered in Death Valley in 1882 and in the following spring at Borate in what was known as the Calico district.

Inyo County: The deposits of Death Valley occur on the east fork of the Black Mountains of the Amargosa Range near its southern end, and immense solid veins or beds of the mineral occur. The important mine is the Lila C., at Ryan, which has been described by Gale[1]. The

mineral was first analysed by Priee[1] with the results shown in analysis No. 1. Analyses 2, 3 and 4 are by Whitfield[1].

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O	
1.	(48.12)	28.43	0.60		--	0.65	22.20	
2.	50.70	27.31			0.10	--	21.87	= 99.98%
3.	49.56	27.36			0.25	0.44	22.66	=100.27
4.	49.62	27.40			0.26	0.47	22.70	=100.45

Some crystals from the Biddy McCarthy mine were shown by Rogers to be pseudomorphs after the new borate, inyoite. The forms occurring were: (001), (110), (010) and (111). Tabular parallel to base. The crystals were formed by dehydration of inyoite.

Kern County: Specimens have come from Lost Hills.

Los Angeles County: An important and extensive deposit occurs near Lang which Eakle[8] described as a variety and called neocolemanite. Hutchinson[1] shows it to be identical with colemanite. It occurs as thin and thick seams, almost vertical, and has considerable howlite associated with it. The mineral has been described and analysed by Eakle. Forms: (001), (010), (100), (210), (110), (230), (011), (021), ($\bar{2}$01), ($\bar{3}$01), (241), (231), (221), ($\bar{6}$61), ($\bar{2}$21), ($\bar{2}$23), ($\bar{2}$11), ($\bar{2}$63).

B_2O_3	CaO	H_2O		
49.45	27.76	22.48	=99.69%	Sp. G.=2.423° at 13° C.

Riverside County: Found in the foothills of San Bernardino Range northeast of Salton Sea.

San Bernardino County: The extensive deposit of colemanite at Borate, in the Calico district, near Yerma, was discovered in the spring of 1883 and became the principal source of the mineral before the Death Valley deposits were worked. Beautiful crystals of the mineral in large geodal masses occur having celestite crystals associated with them. The crystals were first described by Jackson[1][2][3]. Forms: (001), (010), (100), (210), (110), (120), (130), (370), (10.19.0), (011), (021), (201), (101), ($\bar{1}$01), ($\bar{2}$01), ($\bar{3}$01), ($\bar{4}$01), ($\bar{6}$01), (111), (311), (711), (10.1.1), (771), (19.19.6), (331), (731), (131), (121), ($\bar{1}$11), ($\bar{2}$21), ($\bar{3}$31), ($\bar{4}$11), ($\bar{3}$11), ($\bar{2}$11), ($\bar{7}$21), ($\bar{3}$21), ($\bar{2}$31), ($\bar{1}$21), ($\bar{2}$41), ($\bar{1}$31), ($\bar{2}$32), ($\bar{4}$12). Additional forms described by Eakle[2] are: (310), (301), ($\bar{5}$02), ($\bar{8}$01), (522), (142), (141), (164), (165), (232), ($\bar{1}$23), ($\bar{1}$82), ($\bar{3}$41).

Analysis No. 1 is by Hiortdahl[1] and No. 2 by Bodewig[1].

	B_2O_3	CaO	Al_2O_3	Fe_2O_3	MgO	SiO_2	H_2O	
1.	47.64	27.97	0.19		0.13	1.28	22.79	
2.	49.70	27.42	--	--	--	--	22.26	=99.38%

Small amounts of colemanite were found with borax at Searles Borax Lake, Hanks[10]. This is evidently an error in locality.

Ventura County: Deposits of colemanite similar to the Lang deposit exist in the Frazer Mountains and have been mined for some years. These deposits have been described by Gale[3].

Referenees to literature on colemanite: Evans[1][2], Jaekson[1][2][3], Hiortdahl[1], Arzruni[1], Bodewig and von Rath[1], Mulheims[1], Baumhauer[1], Eakle[2][8], Campbell [1][2], Gale[1][2][3].

320. PRICEITE—Pandermite.

Hydrous calcium borate, $5CaO.6B_2O_3.9H_2O$.

Triclinic. Massive, chalky or compact. Snow-white. H=3; G=2.26—2.30.

Refractive indices: $\alpha=1.572$; $\beta=1.591$; $\gamma=1.594$.

Easily fusible and gives green flame. Soluble in dilute hydrochloric acid. Gives water in closed tube.

Priceite and pandermite are identical and form a different speeies from colemanite, with which they have been classed as varieties, Larsen[6].

Inyo County: Priceite has been found as pseudomorphs after ulexite in Death Valley. It occurs associated with the colemanite.

San Bernardino County: Both the chalky priceite and more compact pandermite have been found with the colemanite of the Calico district.

Ventura County: Massive soft pandermite occurs at the colemanite deposit of Frazer Mountains.

321. MEYERHOFFERITE.

Hydrous borate of calcium, $2CaO.3B_2O_3.7H_2O$.

Triclinic. Long prismatic crystals, sometimes tabular parallel to the macropinacoid. Color white or colorless. Vitreous luster. Cleavage brachypinacoidal. H=2; G=2.12.

Refractive indices: $\alpha=1.500$; $\beta=1.535$; $\gamma=1.560$.

Fuses readily with intumescence to an opaque white enamel, giving the green flame of boron. Gives water in a closed tube. Easily soluble in acids.

This new mineral was associated with inyoite as an alteration product. Described, analysed, and named by Sehaller[16].

Inyo County: Occurs as an alteration of the glassy inyoite crystals in the colemanite deposit of Mount Blanco district on Furnace Creek. Forms observed are: (100), (010), (001), (110), (210), (120), (370), (350), (450), (520), (310), (510), (810), $(3\bar{5}0)$, $(1\bar{1}0)$, $(4\bar{3}0)$, $(3\bar{1}0)$, (101), (12.0.11), (706), (605), (504), (705), (302), (12.0.1), $(\bar{1}01)$, (111). Analysis:

CaO	B_2O_3	H_2O under 110°	H_2O ab. 110°	
25.45	46.40	1.01	27.75	=100.61%

322. INYOITE.

Hydrous borate of calcium, $2CaO.3B_2O_3.13H_2O$.

Monoclinic. Large glassy transparent crystals. Cleavage basal. Brittle. H=2; G=1.875.

Refractive indices: $\alpha=1.495$; $\beta=1.51$; $\gamma=1.520$.

Decrepitates on fusing and intumesces, giving the green boron flame. Easily soluble in acids. Gives water in a closed tube.

A new borate from the colemanite deposits of the Death Valley region. Described and named for the county by Schaller[16].

Inyo County: This new borate occurred in the Mount Blanco district on Furnace Creek directly associated with colemanite and its alteration product, meyerhofferite.

Forms observed are: (001), (010), (110) and (111). Crystals tabular to base. Analysis:

CaO	B_2O_3	H_2O under 110°	H_2O ab. 110°	
20.5	[37.2]	26.1	16.2	=100.00

323. ULEXITE—Cottonballs.

Hydrous borate of sodium and calcium, $NaCaB_5O_9.8H_2O$.

Usually in nodules or sheets of fine fibers. Color white. Silky luster. Very soft. G=1.65.

Refractive indices: $\alpha=1.491$; $\beta=1.504$; $\gamma=1.520$.

Fuses with strong yellow flame to a clear glass. Turmeric paper immersed in a hydrochloric acid solution becomes red on drying. Calcium can be determined as the oxalate by precipitation from a very weak hydrochloric acid solution. Gives much water in a closed tube.

The white silky balls of ulexite are frequently found at some of the desert depressions, often with borax.

Inyo County: Ulexite masses are found at some of the sinks in the Death Valley.

Kern County: Ulexite was mentioned from the Cane Spring District by Silliman[8]. Found in quantity in the bed of an extensive salt marsh a few miles north of Desert Wells, W. P. Blake[16].

Los Angeles County: Found in compact divergent masses at Lang with colemanite.

A partial analysis by Foshag gave:

B_2O_3	CaO	N_2O	Na_2O
43.13	14.14	35.68	(7.05)

San Bernardino County: Small amounts occur at the colemanite deposit near Yerma and in the lower part of Death Valley. It has also been found in several places in the Mojave Desert.

324. HYDROBORACITE.

Hydrous borate of calcium and magnesium, $CaMgB_6O_{11}.6H_2O$.

Monoclinic. Fibrous masses. Color white with red spots. H=2; G=1.9—2.

Refractive indices: $\alpha=1.517$; $\beta=1.534$; $\gamma=1.565$.

Fuses easily to a clear glass and colors flame green. Calcium and magnesium can be determined by precipitation from a weak hydrochloric acid solution. Gives much water in closed tube. Gives also the wet test for boron with turmeric paper.

Inyo County: Occurs in acicular aggregates with the colemanite at Ryan.

San Bernardino County: Found with colemanite near Yerma, but in subordinate amounts.

Ventura County: Said to occur at the colemanite mines of Frazer Mountains.

325. BAKERITE.

Hydrous silico-borate of calcium, $8CaO.5B_2O_3.6SiO_2.6H_2O$.

Amorphous. Massive. Color white to faint green. H=4.5; G=2.73.

Refractive index: $n=1.583$.

The reactions obtained for bakerite are the same as those for howlite.

San Bernardino County: This new borate was found in the Mojave Desert, about sixteen miles northeast of Daggett, associated with howlite and ulexite. Described and named by Giles[1].

	B_2O_3	CaO	SiO_2	H_2O	$Al_2O_3Fe_2O_3$
White	27.74	34.88	28.45	8.30	0.63
Faint green	26.85	35.22	28.05	8.66	0.22

326. HOWLITE.

Hydrous silico-borate of calcium, $H_5Ca_2B_5SiO_{14}$.

Orthorhombic? Round nodules, massive, chalky. Color white. Dull luster. H=1—3.5; G=2.5.

Refractive indices: $\alpha=1.586$; $\beta=1.598$; $\gamma=1.605$.

Fuses easily and colors the flame green. Easily soluble and precipitates silica. Calcium is precipitated with ammonium oxalate from a weak hydrochloric acid solution. Yields water in a closed tube. Gives the boron reaction with turmeric paper.

Howlite is an associate of the other borates, but owing to the silica present it is not utilized, although it contains a large amount of boric oxide.

Inyo County: Massive howlite is associated with the colemanite at Ryan.

Los Angeles County: Large masses of compact white howlite are common in the colemanite deposit near Lang, and the mineral has been described and analysed by Eakle[8].

B_2O_3	CaO	SiO_2	H_2O	
45.56	28.26	14.81	11.37	=100.38%

San Bernardino County: Large masses occur associated with bakerite and ulexite in the Mojave Desert, sixteen miles northeast of Daggett, Giles[1]. Analyses No. 1 is of soft scaly, and No. 2 of hard rock-like material, made by Giles. Analysis No. 3 is of soft white material, made by Wm. Lawson.

	B_2O_3	CaO	SiO_2	H_2O	$MgONa_2O$	
1.	44.38	28.45	15.50	11.58	0.09	
2.	43.78	28.44	15.33	11.39	1.06	
3.	44.32	29.22	15.31	11.44	--	=100.29%

NIOBATES-TANTALATES.

The niobate-tantalate group of minerals are characteristic of acid pegmatite veins. They are mostly of high specific gravity, varying in color from yellow to brown and black, and often contain the rare-earth oxides.

327. PYROCHLORE.

Niobate of titanium, calcium, cerium and thorium.

Isometric. Commonly in octahedrons. Color dark reddish brown. Streak light yellowish brown. H=5—5.5; G=4.32.

Refractive index: $n=1.96$.

Insoluble and infusible. Fused with borax as a flux, the fused mass powdered and then dissolved by boiling in hydrochloric acid. If metallic tin is added and the solution boiled down to small bulk, the color of the solution becomes at first violet, due to titanium, and then blue, due to the niobium.

San Diego County: A dark brown isotropic mineral, presumably pyrochlore, surrounded by microlite, came from some locality in the county, Rogers[5].

328. MICROLITE.

Tantalate of calcium, $Ca_2Ta_2O_7$.

Isometric. Often small octahedrons. Color pale yellow to brown. Luster resinous. H=5.5; G=5.48.

Refractive index: $n=1.925$.

Insoluble and infusible. The reactions are similar to those for pyrochlore. Fused with potassium bisulphate or potassium hydroxide, the fusion dissolved in hydrochloric acid and the solution boiled down with tin, it assumes a deep blue color.

San Diego County: This rare tantalate has been found in the county, exact locality unknown, as a honey-yellow mineral associated with albite, lepidolite, tourmaline and colorless apatite. A few crystals are octahedral with narrow faces of (011) and (311), Rogers[5].

329. COLUMBITE—TANTALITE.

Niobate of iron and manganese $(Fe,Mn)Nb_2O_6$.

Orthorhombic. Prismatic crystals, massive. Color iron-black, brownish black. Submetallic luster. Streak dark brown to black. H=6; G=5.3—7.3.

Refractive indices: $\alpha=2.19$; $\beta=2.25$; $\gamma=2.34$.

Insoluble and practically infusible. Fused with potassium bisulphate, then dissolved in hydrochloric acid and the solution boiled down with tin, it assumes a deep blue color. Gives the green color of manganese when fused with sodium carbonate.

Fresno County: Massive and crystalline black columbite has been found at the Reynolds mine, Kings River district.

San Diego County: Crystals from the Little Three mine, near Ramona, were described by Eakle[6]. Forms: (100), (010), (110), (130), (150), (160), (021), (111), (221), (211), (121), (131), (141). Small imperfect crystals found at the Victor mine, Rincon, have the forms: (100), (210), (130), (103), (133), Rogers[3]. Occurs in good crystals associated with cassiterite, tourmaline albite and orthoclase in the Chihuahua Valley, Schaller[18].

330. STIBIOTANTALITE.

Niobate and tantalate of antimony, $m(SbO)_2Nb_2O_6.n(SbO)_2Ta_2O_6$.

Orthorhombic. Hemimorphic prisms, twinned. Color light brown to dark brown. Resinous to adamantine luster. H=5—5.5; G=5.98—7.37, mostly 6.6—6.7. Pyroelectric.

Refractive indices: $\alpha=2.374$; $\beta=2.404$; $\gamma=2.457$.

Reduced on charcoal with sodium carbonate, it gives a white coating and metallic brittle bead of antimony. Fused with potassium bisulphate, fusion dissolved in hydrochloric acid, and the solution boiled down with metallic tin assumes the blue color due to niobium and tantalum.

San Diego County: This rare mineral was found in small amounts in the pegmatite veins at Mesa Grande associated with gem tourmaline, pink beryl, quartz, orthoclase, lepidolite and cassiterite. It was described and analysed by Penfield and Ford[1]. Forms: (100), (110), (130), (209), (203), (4.12.9), (043), (100), (110), (130), (209), (203), (4.12.9). The analyses show a varying amount of niobium and tantalum to antimony.

$(Nb,Ta)_2O_5$	Sb_2O_3	Bi_2O_3		
55.33	44.26	0.33	= 99.92%	Sp.G.=6.72
50.30	49.28	0.53	=100.11	Sp.G.=5.98

$(Nb,Ta)_2O_5$		Nb_2O_5	Ta_2O_5
55.33	=	18.98	36.35%
50.30	=	39.14	11.16%

The mean of three analyses of this stibiotantalite by Foote and Langley[1] gave:

Sb_2O_3	Bi_2O_3	Ta_2O_5	Nb_2O_5
40.95	0.60	41.92	16.19 = 99.66%

TUNGSTATES.

The three valuable tungsten minerals, scheelite, wolframite and hübnerite, have been found in several localities in the State, but only scheelite has until lately been worked for tungsten. The manganese tungstate, hübnerite, usually contains iron and grades into the iron-manganese tungstate, wolframite.

331. WOLFRAMITE—HÜBNERITE.

Tungstate of manganese and iron $(Mn,Fe)WO_4$.

Monoclinic. Thick tabular crystals and massive. Perfect clinopinacoidal cleavage. Color dark grayish or brownish black, brownish red. Thin splinters often deep red. Streak dark brown to black. Luster metallic to submetallic. $H=5-5.5$; $G=7.2-7.5$.

Refractive indices: $\alpha=2.26$; $\beta=2.32$; $\gamma=2.42$. (Wolframite.)

Refractive indices: $\alpha=2.17$; $\beta=2.22$; $\gamma=2.32$. (Hübnerite.)

Fusible, but rather insoluble. Fused with sodium carbonate, gives blue-green fusion; the fused mass dissolved in hydrochloric acid and then boiled down with metallic tin, the solution becomes deep blue, later turning to brown. The phosphorous salt bead of tungsten in the reducing flame is a fine blue.

Inyo County: Boulders of black wolframite have been found in Death Valley.

Kern County: Occurs with chalcopyrite at Woody.

Madera County: Large crystals and masses weighing several pounds occur in quartz, about twelve miles north of Raymond. The quartz vein with the wolframite is in an andalusite schist.

Mariposa County: Crystals and massive wolframite have been found near Buchanan.

San Bernardino County: Veins of wolframite with some scheelite have been located in the Clark Mountains. Hübnerite associated with triplite occurs at Camp Signal about nine miles north of Goffs. Occurs in a quartz vein with chalcopyrite, sphalerite and galena at the Sagamore mine, New York Mountains.

Siskiyou County: Said to occur in quartz in one of the mines of the county.

332. SCHEELITE.

Tungstate of calcium, $CaWO_4$.

Tetragonal. Pyramidal crystals and massive. Color white, yellow, brown. Vitreous luster. H=4.5 — 5; G=5.9 — 6.1.

Refractive indices: ϵ=1.934; ω=1.918.

Difficult to fuse and only soluble by boiling in strong hydrochloric acid, the solution becomes bright yellow and tungstic oxide is precipitated. On the addition of tin and boiling, the solution turns blue and later brown. Ammonia and ammonium oxalate added to the diluted hydrochloric acid solution will precipitate the calcium.

Scheelite is the principal tungsten mineral of the State and important deposits exist. It is frequently found in isolated crystals and patches in quartz-feldspar veins and has been reported from several localities.

Fresno County: Found at contact of limestone and granite near Trimmer. Reported from thirty miles northwest of Coalinga.

Inyo County: Scheelite in white and yellowish grains and occasionally in crystals intermixed with a dark brown garnet mass occurs in Deep Canyon about eight miles west of Bishop, and also at several points a few miles south. Other minerals of the district are: sillimanite, quartz, muscovite, diopside, wollastonite, epidote, vesuvianite, calcite, phlogopite, apatite, andesite, titanite, biotite and quartz. The deposit is of contact metamorphic origin and has been described by Knopf[3].

Kern County: Small amounts of scheelite occur in the Amalie, Rand and Stringer districts, associated with gold. Occurs in the Yellow Aster mine, Randsburg, and in the Winnie, Sidney and other mines of the Stringer district. Occurs in massive green epidote with quartz and calcite at the Cadillac claims, Greenhorn mining district, near Kernville. Found with wolframite in Slick Rock Canyon near Glennville. As a contact mineral near Weldon. In the Amalie district it occurs in Jawbone Canyon with pyrite and gold-bearing Galena. Occurs with molybdenite and possibly powellite in Black Mountains about twenty miles northwest of Randsburg. Occurs in a garnetiferous rock on the west slope of Greenhorn Mountains along Cedar and Slick Rock Creeks. The garnet rock also contains pyrrhotite, pyrite, chalcopyrite, hornblende, black tourmaline, quartz and feldspar. Sheelite and quartz as veinlets occur in a hornblende schist at the Cottonwood mine, Kelso district.

Nevada County: A few brownish yellow masses were found in a quartz ledge at Howard Hill, Grass Valley, Hanks[6]. Small amounts of reddish brown scheelite occurred at the 3,000-foot level of the Empire mine, Grass Valley. Veins of white scheelite intermixed with quartz and feldspar occur at the Union Hill mine, Grass Valley, and is mined.

San Bernardino County: The most important veins of scheelite occur at Atolia in the Papoose and other claims. The scheelite occurs in a

quartz-feldspar vein, and is generally intimately mixed with the gangue, forming a low grade ore. Some scheelite is associated with wolframite in Clark Mountain. Occurs in limestone at contact with granite associated with garnet and epidote in clear pyramidal crystals in the Morengo district. Sometimes massive up to three feet in width and high grade.

San Diego County: Massive brown scheelite has been found at Julian. It occurs in quartz five miles southeast of Laguna Mountains.

Siskiyou County: Scheelite in crystals has been observed at Scott Bar.

Tulare County: Small amounts of yellow scheelite have come from a locality east of Visalia.

Tuolumne County: A small amount found on the Mackey Ranch, three miles from Jamestown.

333. CUPROSCHEELITE—Cuprotungstite.

Tungstate of copper and calcium $(Ca.Cu)WO_4$.

Granular, incrustations. Color olive-green, pistachio-green. Vitreous luster. H=4.5—5.

Refractive index: β=2.15.

Cuproscheelite will give similar reactions to scheelite. The presence of copper can be told by the borax bead.

Kern County: Reported to have been found with radiating black tourmaline at the Green Monster mine, twelve miles east of White River, Hanks[1].

MOLYBDATES.

334. WULFENITE.

Molybdate of lead, $PbMoO_4$.

Tetragonal. Thin tabular crystals; sometimes pyramidal. Color orange-yellow, bright red. Adamantine luster. H=2.5—3; G=6.7—7.

Refractive indices: $_{\epsilon}$=2.304; $_{\omega}$=2.402.

Reduced on charcoal, using sodium carbonate as flux, it yields metallic lead and a yellow coating. Easily fusible and soluble. Powder dissolved in a few drops of strong sulphuric acid by boiling, gives a solution which turns blue when a small amount of organic matter is introduced, a piece of paper the size of a pin head generally being sufficient; the blue solution turns brown in a short time.

El Dorado County: Occurs in small grains near Garden Valley.

Inyo County: Crystals of wulfenite occurred with the linarite and caledonite of the Cerro Gordo mine. Has been observed in the Darwin mines associated with crocoite.

Kern County: Wulfenite was found six miles northeast of Kane Springs, Hanks[6].

Plumas County: Found at the Diadem Lode on Mumford Hill.

Riverside County: Occurs associated with crocoite at the El Dorado mine near Indio. Said to occur in the gold mine of Chuckawalla Mountains.

San Bernardino County: Considerable wulfenite was found with the lead carbonate of the Silver Reef district, Storms[1]. Light red crystals of wulfenite occurred with galena, mimetite and malachite about eighty miles north of Barstow. Crystals coming from Lavic were described by Guild and Wartman[1]. Forms observed were: (001), (012), (011), (113), (111) and (133). Occurs associated with vanadinite at the Vanadium King mine near Goffs.

San Luis Obispo County: Found at the Fairview mine.

335. POWELLITE.

Molybdate of calcium, $CaMoO_4$

Tetragonal. Minute pyramids. Color greenish yellow. H=3.5; G=4.53. Refractive indices: ϵ=1.967; ω=1.978.

Fusible with difficulty to a gray mass. Soluble in nitric and hydrochloric acids. A deep blue solution is obtained by boiling the powdered mineral in a few drops of strong sulphuric acid and adding a pin-head scrap of paper.

Powellite is a rare molybdate and is formed as a secondary mineral usually by the alteration of molybdenite.

Kern County: Found in the Black Mountains as an oxidation product from molybdenite with which it is associated.

URANATES.

The uranium minerals are very rare and only one or two specimens of them have been found in California. All uranates are highly radioactive and pitchblende is one of the ores of radium, so it is a very valuable mineral.

336. URANINITE—Pitchblende.

Uranate of uranyl, lead and the rare earths.

Isometric. Crystals rare. Generally massive and granular. Color grayish to brownish black. Streak brownish black or greenish. Submetallic to pitch-like luster. H=5.5; G=9—9.7.

The phosphorous salt bead of uranium is yellowish-green in the oxidizing flame and a fine clear green in the reducing flame. Uranium minerals are very heavy and all are strongly radioactive.

Calaveras County: The only known occurrence of the heavy brown pitchblende was at the Rathgeb mine, near San Andreas, where it was found in acicular crystals in a pocket with spongy gold, quartz and clay, Rickard[1].

337. URACONITE—Uranocher.

Hydrous uranate or sulphato-uranate.

Amorphous, earthy or scaly. Color lemon-yellow.

Refractive indices: $\alpha = 1.75$; $\beta = 1.79$; $\gamma = 1.85$.

In addition to the uranium reaction, the mineral will give water in a closed tube.

Calaveras County: This occurs as an alteration product of pitchblende at the Ratgeb mine, in coatings immediately in contact with the gold, Rickard[1].

CHAPTER XI.

SULPHATES AND HYDROCARBONS.

Anhydrous.	*Hydrous.*	
Mascagnite	Mirabilite	Pickeringite
Thenardite	Gypsum	Halotrichite
Aphthitalite	Epsomite	Sonomaite
Arcanite	Goslarite	Coquimbite
Glauberite	Morenosite	Alunogen
Barite	Melanterite	Romerite
Celestite	Pisanite	Copiapite
Anglesite	Bieberite	Knoxvillite
Anhydrite	Boothite	Redingtonite
Sulfohalite	Chalcanthite	Fibroferrite
Hanksite	Blödite	Botryogen
Leadhillite	Boussingaultite	Alunite
Caledonite	Kalinite	Jarosite
Brochantite	Tschermigite	Durdenite
Linarite	Mendozite	

ANHYDROUS.

338. MASCAGNITE.

Sulphate of ammonium $(NH_4)_2SO_4$.

Orthorhombic. Generally in mealy crusts. Color lemon-yellow, yellowish gray. Vitreous to dull luster. H = 2 — 2.5; G = 1.76 — 1.77. Bitter taste.

Refractive indices: $\alpha = 1.521$; $\beta = 1.523$; $\gamma = 1.533$.

Soluble in water and very easily fusible. Boiled in a test tube with potassium bisulphate, it gives off the odor of ammonia. Barium chloride added to the solution precipitates barium sulphate.

Sonoma County: Goldsmith[1] reported finding mascagnite with boussingaultite in this county but the locality was not given.

339. THENARDITE.

Sulphate of sodium, Na_2SO_4.

Orthorhombic. Pyramidal crystals. Color white. Vitreous luster. H = 2.68—3; G = 2.68—2.69.

Refractive indices: $\alpha = 1.464$; $\beta = 1.474$; $\gamma = 1.485$.

Soluble in water. Barium chloride precipitates barium sulphate. Fuses easily, coloring the flame intensely yellow.

Imperial County: Extensive deposit of the sodium sulphate occurs about 2½ miles from Pope Siding.

Inyo County: White masses of sodium sulphate occur in the Funeral Range and in the dry depressions of Death Valley. Large crystals, some twinned, occur at Deep Springs Valley. The crystals are blue-gray, having the forms (001) and (110), some in cruciform twins.

San Bernardino County: Thenardite forms layers several feet in thickness at the Searles Borax Lake. Large crystals of it occur often as cruciform twins. The crystals were described by Ayers[1]. Forms: (110), (001), (111), (106), (100).

San Luis Obispo County: Soda Lake on the Carissa Plains, a depression between the Caliente and Tremblor ranges, is a dry lake with crusts of sodium sulphate. Analysis of this crust by Steiger gave:

Insol.	Al_2O_3	MgO	CaO	Na_2O	K_2O	H_2O	SO_3	Cl		O	
0.40	0.04	1.66	0.45	40.50	0.28	3.65	46.12	9.27	=102.37%	— 2.09	=100.28

340. APHTHITALITE.

Sulphate of potassium and sodium, $(K,Na)_2SO_4$.

Rhombohedral. Tabular crystals and crusts. Color white-transparent. Taste saline and bitter. H=3—3.5; G=2.63—2.65.

Refractive indices: ϵ=1.499; ω=1.491.

Fuses with yellow flame which shows violet through blue glass. Barium chloride precipitates barium sulphate. Soluble in water.

The double salt of potassium and sodium sulphate is sometimes formed in a lake deposit or about the vent of a volcano.

San Bernardino County: Is present as the only recognized potash mineral occurring at Searles Lake. Obtained from well G 75 in colorless crystals associated with halite on a mass of borax. The mineral was analysed and its occurrence described by Foshag.

K	Na	SO_4	Cl	H_2O	
32.46	9.01	53.71	4.76	0.10	= 100.04

This is equivalent to K_2SO_4 72.87%; Na_2SO_4 18.38%; NaCl 7.87%.

341. ARCANITE.

Sulphate of potassium, K_2SO_4.

Orthorhombic. Thin basal plates. Colorless, yellowish. Vitreous luster. H=2.

Refractive indices: α=1.494; β=1.495; γ=1.497.

Like thenardite in its reactions, except that the flame is violet.

Orange County: Found as thin crystals in a mine-timber in Tunnel No. 1 of the Santa Ana Tin Mining Company in Trabuca Canyon. The crystals are twinned on the prism and have the forms: (001), (111), (112), (102), Eakle[7].

342. GLAUBERITE.

Sulphate of sodium and calcium, $Na_2SO_4.CaSO_4$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Color yellowish white or gray. Vitreous luster. H=2.5—3; G=2.7—2.85.

Refractive indices: $\alpha=1.515$; $\beta=1.532$; $\gamma=1.536$.

Partly soluble in water and completely soluble in dilute acid. Calcium is precipitated from the acid solution by adding ammonia and ammonium oxalate. Fuses easily, coloring the flame yellow.

San Bernardino County: The double salt of soda and lime is also a very prominent mineral in the deposit at Searles Borax Lake. It is found in platy crystals with the forms: (001), (111), vom Rath[1].

343. BARITE—Heavy Spar.

Sulphate of barium, $BaSO_4$.

Orthorhombic. Tabular and prismatic crystals, massive, lamellar, granular, concretionary. Cleavage perfect basal and good prismatic. Color white, yellow, brown. Vitreous luster. H=2.5—3.5; G=4.3—4.6.

Refractive indices: $\alpha=1.636$; $\beta=1.637$; $\gamma=1.648$.

Insoluble in acids. Fuses with decrepitation and colors the flame green. Fused with sodium carbonate and the fused mass leached with boiling water, gives the sulphate in solution, which can be tested with barium chloride and leaves the precipitate as barium carbonate, which can be tested for barium.

Barium sulphate is one of the common minerals of the State and some deposits of it occur. It is commonly found as a gangue mineral in vein deposits, and is especially associated with galena, and therefore prominent in silver-lead districts.

Alpine County: Found with pyrite and enargite at the Morning Star mine.

Butte County: With gold at the Pinkstown ledge, Big Bend Mountain, Turner[1].

Calaveras County: Occurs on Carson Hill with quartz and gold. Also with the pyrite at Copperopolis and at Campo Seco.

El Dorado County: Yellow platy barite occurs on Slate Mountain and ten miles above Georgetown.

Fresno County: Nodules and large concretions of dark gray impure barite occur in the Mount Diablo Range.

Inyo County: Massive barite occurs near Independence; at the Defiance mine with native sulphur; white massive at Bishops Creek, White Mountains; veins in the Alabama Range. Deposits of massive barite occur twenty miles west of Shoshone.

Kern County: Nodular masses in the Mount Diablo Range.

Lake County: Some barite has been found near Glenbrook.

Los Angeles County: White barite occurs near Azusa. Barite was a gangue mineral in the old Kelsey mine, San Gabriel Canyon, Storms[1].

Mariposa County: A large deposit of barite occurs about two miles west of El Portal which has produced much of the mineral mined in the State. The barium carbonate, witherite, is associated with it.

Mendocino County: A large deposit occurs near Castella on mountains east side of river, Castle Crags.

Merced County: A triboluminiscent sphalerite mixed with barite occurs near Merced Falls.

Mono County: Barite has been found as a gangue mineral near Bodie, Benton and other mining districts. Some barite has been found in the Mono Lake district.

Monterey County: A deposit occurs on Fremont Peak.

Napa County: Plates of barite occur at the Manhattan mine, Knoxville, with cinnabar; platy quartz as pseudomorphs after barite also are common at this mine. Occurs associated with cinnabar at the Oat Hill mine.

Nevada County: Occurs with gold at the Malakoff mine, North Bloomfield. Slender prisms of barite in a limonite gangue associated with gold occur at Pine Hill and these crystals have been described by Eakle[6]. Forms: (100), (010), (110), (210), (320), (530), (130), (001), (102), (011), (111), (113). A large deposit of white barite occurs five miles north of Alta. Round concretions have been found at the Buckeye Hill mine. White veins of barite occur near Graniteville. Large deposit five miles northeast of Washington, pure white.

Orange County: A white barite gangue occurred with the tiemannite of San Joaquin Ranch mine.

Placer County: White barite comes from near Lincoln.

Plumas County: Found associated with lead and copper minerals in Indian Valley. Small veins occur in altered andesite at Indian Valley Silver Mine.

San Benito County: Pure white barite occurs in limestone on Bardin Ranch, Fremont Peak.

San Bernardino County: Barite was common as a gangue in the silver districts of Calico and Barstow, occurring as white and yellow platy masses, Lindgren[1], Storms[1]. Also common at the Imperial mine. Occurs six miles north of Barstow in limestone. White barite has been found near Trona. One of the minerals occasionally found at Randsburg. Reported as a deposit near Ludlow.

San Diego County: Occurs on Red Mountain.

San Francisco County: Needles of barite have been found at Fort Point.

San Mateo County: Massive barite has been found on Permenente Creek.

Santa Barbara County: White massive at Santa Maria. White massive on north fork of La Brea Creek, twenty miles from Sisquoc. Wide white vein in sandstone on ridge above north fork of La Brea Creek.

Santa Clara County: Occurred in small amounts with ganophyllite in the manganese boulder found near Alum Rock Park, five miles east of San Jose. Crystals had the forms: (110), (111) and (001), Rogers[9]. Occurs as veins in an old cinnabar mine on Yagis Creek, eight miles from Gilroy. Found as coarsely crystallized masses in the Solis district.

Shasta County: Barite occurs at several of the copper mines as a gangue mineral, but the amount is small. A large deposit of white massive barite occurs 2½ miles north of Baird. Large deposit occurs near Copper City.

Siskiyou County: Found with argentiferous galena about 2½ miles north of Callahan.

Trinity County: Dark gray barite occurs about fifteen miles below Hayfork. Small tabular crystals occur in gold ores of Five Pines mine associated with pink calcite, and also at Delta mine, Weaverville Quadrangle.

344. CELESTITE.

Sulphate of strontium, $SrSO_4$.

Orthorhombic. Crystals and massive. Cleavage perfect basal. Colorless, pale bluish. Vitreous luster. H=3—3.5; G=3.95—3.97.

Refractive indices: $\alpha=1.622$; $\beta=1.624$; $\gamma=1.635$.

Similar to barite in its reactions, except that the flame is deep carmine red. Slightly soluble in acid.

Imperial County: Celestite associated with gypsum beds occurs in the Fish Creek Mountains, thirty miles west of Brawley.

Inyo County: Slender bluish crystals occur with the colemanite of Death Valley and these have been measured by Eakle[7]. Forms: (001), (110), (102), (104), (011), (122), (067).

Mono County: Blue celestite has come from the county.

San Bernardino County: Long crystals occur with the colemanite of Calico similar to those from Death Valley. Celestite was reported as one of the associated minerals of Searles Borax Lake by Hanks[9]. A large deposit showing as white outcrops visible from the railroad occurs on southern base of a mountain four miles northeast of Lavic. Occurs as veins in walls of jasper, Mallery[1]. Some celestite is associated with the strontianite on Strontium Hills, ten miles north of Barstow.

345. ANGLESITE.

Sulphate of lead, $PbSO_4$.

Orthorhombic. Prismatic crystals and massive. Colorless, white, yellow, gray, brown. Adamantine luster. H = 2.5 — 3; G = 6.12 — 6.39.

Refractive indices: $\alpha = 1.877$; $\beta = 1.882$; $\gamma = 1.894$.

Reduced on charcoal, using sodium carbonate as flux, to metallic lead. Slightly soluble and barium chloride added to the acid solution precipitates barium sulphate.

The sulphate of lead is a very common oxidation product of galena, consequently it is often found in lead districts usually in small amounts.

Inyo County: Considerable anglesite has been formed from the lead sulphides in the Cerro Gordo district. Found associated with bindheimite, galena and linarite at the Modoc mine; gray masses banded with cerussite occur at the Cerro Gordo mine. Good crystals associated with linarite and caledonite have come from this mine, with the forms: (001), (100), (110), (104), (111), (122), Eakle[7]. Crystals with the forms: (001), (102), (011), (112), (111), (122), (324), (110), (120) and (010) were described by Guild[1]. Associated with cerussite and galena in limestone at the Ubehebe mine.

Kern County: Anglesite as an oxidation of lead sulphide occurs seven miles northwest of Randsburg.

Mono County: Anglesite occurs with galena in the Benton district.

Riverside County: Anglesite has been identified as one of the minerals at the Crestmore quarry.

San Bernardino County: Massive and in crystals at the Ibex mine, Black Mountains.

346. ANHYDRITE.

Sulphate of calcium, $CaSO_4$.

Orthorhombic. Generally granular or lamellar massive. Color white, bluish white. Vitreous luster. H = 3 — 3.5; G = 2.89 — 2.98.

Refractive indices: $\alpha = 1.571$; $\beta = 1.576$; $\gamma = 1.614$.

Soluble in hydrochloric acid and barium chloride added will precipitate barium sulphate. Calcium is precipitated by adding ammonia and ammonium oxalate to the dilute acid solution. Gives no water in a closed tube.

Inyo County: Found massive at the St. Ignacio and Cerro Gordo mines. Also in the Panamint and Funeral Ranges.

Mono County: Associated with barite at the Mammoth mine, Mineral Hill.

Orange County: Found in the Santa Ana Mountains, near Anaheim, Hanks[6].

San Bernardino County: Anhydrite is mentioned as one of the associated minerals at Searles Borax Lake, Hanks[9]. Deposits with

gypsum on the Owl Mountains, near Owl Springs, and on Avawatz Mountains.

San Diego County: Some anhydrite has been found at Mesa Grande.

Shasta County: Anhydrite partly altered to gypsum occurs at the deep levels of Bully Hill and Rising Star mines.

347. SULFOHALITE.

Chloro-sulphate of sodium, $3Na_2SO_4.2NaCl$.

Isometric. Rhombic dodecahedrons with cubes and tetrahedrons. Color faint greenish yellow. Vitreous luster. H=3.5; G=2.489.

Refractive index: n=1.454.

Soluble in water, and barium chloride precipitates barium sulphate. Silver nitrate precipitates from the solution acidified with nitric acid, silver chloride. Fuses with intumescence, coloring the flame yellow.

San Bernardino County: Found as small crystals implanted on hanksite, at Searles Borax Lake, and was described as a new mineral and named by Hidden and Mackintosh[1][2]. Forms: (111), (101), (100).

SO_3	Cl	Na_2CO_3		Na_2SO_4	NaCl	Na_2CO_3		
42.48	13.12	1.77	=	75.41	21.62	1.77	=98.80%	Sp.G=2.489

Small crystals of sulphohalite as octahedrons were described by Gale and Hicks[1] from Searles Lake. Analysis by Hicks:

SO_3	Na_2O	Na	Cl	F	Loss above 200° C
42.00	32.50	11.35	9.19	[4.71]	0.25

Equivalent to $2Na_2SO_4.NaCl.NaF$.

348. HANKSITE.

Carbonato-sulphate of sodium, $4Na_2SO_4.Na_2CO_3$.

Hexagonal. Prismatic, tabular. Color white. Vitreous luster. H=3—3.5; G=2.562. Taste saline.

Refractive indices: ϵ=1.461; ω=1.481.

Easily soluble in water. Shows a slight effervescence when dropped into dilute hydrochloric acid. Barium chloride precipitates barium sulphate. Fuses easily, coloring the flame yellow. Potash is sometimes present, giving a violet flame when seen through blue glass or the Merwin color screen.

The double soda salt is quite common in the borax lake districts where it has crystallized in large hexagonal crystals. It was discovered as a new mineral in 1885 and its occurrence is practically limited to this State.

Inyo County: Some hanksite is found with the borax in the sinks of Death Valley.

San Bernardino County: First discovered at Searles Borax Lake as one of the numerous crystallization products and was described as a new mineral and named by Hidden[1], with an analysis by Mackintosh.

Forms: (0001), (10$\bar{1}$0), (10$\bar{1}$1), (20$\bar{2}$1), (40$\bar{4}$5). Analysed by Mackintosh, Dana and Penfield[1] and by Pratt[1].

	SO_3	CO_2	Cl	Na_2O	K_2O	Insol.	Ign.	
Mackintosh	45.89	5.42	2.36	46.34	--	--	--	= 99.99%
Penfield	43.59	5.42	2.13	40.86	2.33	4.41	1.32	= 100.06
Pratt	45.93	5.65	2.21	43.35	2.48	0.19	--	= 99.81
	45.78	5.63	2.28	43.61	2.31	0.12	--	= 99.73

349. LEADHILLITE.

Carbonato-sulphate of lead, $4PbO.SO_3.2CO_2.H_2O$.

Monoclinic. Tabular crystals. Cleavage perfect basal. Color white, yellowish, greenish. Vitreous to pearly luster. H = 2.5; G = 6.26 — 6.49.

Refractive indices: $\alpha = 1.87$; $\beta = 2.00$; $\gamma = 2.01$.

Easily reduced on charcoal to metallic lead, giving a yellow coating. Effervesces slightly in hydrochloric acid. Barium chloride precipitates from the acid solution barium sulphate. Gives a small amount of water in a closed tube.

Inyo County: Found as pale sea-green crystals at the Cerro Gordo mine, associated with linarite and caledonite, with the forms: (001), (110), (100), and a prism. Rogers[1].

350. CALEDONITE.

Basic sulphate of lead and copper $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Orthorhombic. Small crystals. Cleavage perfect basal. Color bluish green and dark emerald-green. Resinous to vitreous luster. H = 2.5—3: G = 6.4.

Fused on charcoal with sodium carbonate, it becomes reduced to metallic lead globules and coats the coal yellow near the assay. Barium chloride added to the hydrochloric acid solution precipitates barium sulphate: ammonia added to the solution gives the blue color due to copper. Gives a small amount of water in a closed tube. Easily fusible.

Inyo County: Occurs as small emerald-green crystals associated with linarite and brochantite at Cerro Gordo. Described by Eakle[7]. Forms: (001), (110), (0$\bar{1}$0), (011), (111), (201), (021), (012), (013), (221), (223), (014), (203). Bright green crystals from Cerro Gordo described by Guild[1] had the forms: (001), (011), (010), (113), (223), (221), (110) and (201).

351. BROCHANTITE.

Basic sulphate of copper, $CuSO_4.3Cu(OH)_2$.

Orthorhombic. Small crystals. Cleavage perfect brachypinacoidal. Color emerald-green, dark green. Vitreous luster. H = 3.5 — 4; G = 3.907.

Refractive indices: $\alpha = 1.730$; $\beta = 1.778$; $\gamma = 1.803$.

Easily fusible. Reduced on charcoal with sodium carbonate, yields metallic copper. Barium chloride precipitates barium sulphate from a hydrochloric acid solution. Ammonia added to solution gives a blue color. Gives water in a closed tube.

Calaveras County: Druses of small dark green crystals, derived from chalcopyrite, occur at Copperopolis, Rogers[5].

Inyo County: Occurs as small dark emerald-green crystals at the Cerro Gordo mine, associated with linarite and caledonite. The crystals have the forms: (010), (110), (120), (001), (012), (101), (041). Eakle[7]. Occurs with chrysocolla in the Panamint Mountains near headwaters of Cottonwood Creek.

Plumas County: Occurs in crystals at the Engels Copper mine.

San Bernardino County: Observed as coatings on breccia at Stagg.

352. LINARITE.

Basic sulphate of lead and copper $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.

Monoclinic. Small crystals, divergent columnar and platy. Cleavage perfect orthopinacoidal. Color deep azure-blue. Streak pale blue. Vitreous to adamantine luster. H=2.5; G=5.3—5.45.

Refractive indices: $\alpha=1.809$; $\beta=1.838$; $\gamma=1.859$.

Reactions for linarite are like those for caledonite. The two are often associated, but are easily distinguished by color.

Inyo County: Beautiful divergent, columnar masses of deep azure-blue linarite were obtained in the Cerro Gordo mines during the early days of mining there, the specimens sometimes being banded with green caledonite and brochantite. Fine crystals were also obtained from pockets and cavities in the massive mineral. The Cerro Gordo, Crapo, St. Ignacio and other mines of the locality contained the linarite in the oxidized zones of the deposit. Rogers[1] gives several of the forms on the linarite crystals. Forms: (001), (100), (110), (010), ($\bar{2}$01), ($\bar{1}$01). Eakle[7] gives additional forms: (210), (012), (011), ($\bar{2}$03), ($\bar{1}$12), ($\bar{2}$11), ($\bar{7}$16), ($\bar{1}\bar{4}$.0.1), ($\bar{3}$02), (211). Crystals show twinning on the orthopinacoid.

HYDROUS.

353. MIRABILITE—Glauber Salt.

Hydrous sulphate of sodium, $Na_2SO_4.10H_2O$.

Monoclinic. Generally as crusts and efflorescences. Color white. Vitreous luster. H=1.5—2; G=1.48. Taste salt and bitter.

Refractive indices: $\alpha=1.394$; $\beta=1.396$; $\gamma=1.398$.

Soluble in water. Gives an intense yellow flame when heated. Barium chloride precipitates from the acid solution barium sulphate. Gives much water in a closed tube.

Mirabilite generally occurs as white crusts and efflorescences and it is sometimes found on the walls of mines where sulphide ores are decomposing. It is also found as crusts about dry alkali lakes.

Imperial County: Glauber salt is associated with the thenardite at Pope Siding.

Napa County: It occurred on the walls of the tunnels in the old Redington cinnabar mine, Knoxville.

San Bernardino County: Forms crusts about some of the dry salt basins of this county.

San Luis Obispo County: Found on Carrizo Plains.

354. GYPSUM—Gypsite.

Hydrous sulphate of calcium, $CaSO_4.2H_2O$.

Monoclinic. Crystals, massive, granular, fibrous, lamellar. Cleavage perfect clinopinacoidal. Colorless, white, light brown, reddish. Vitreous luster. H=1.5; G=2.31—2.32.

Refractive indices: $\alpha=1.520$; $\beta=1.523$; $\gamma=1.530$.

Easily soluble in dilute hydrochloric acid. Ammonia and ammonium oxalate added to the solution precipitates calcium oxalate. Gives water in a closed tube and crumbles to a white powder.

Gypsum is a very common mineral in the State, but extensive deposits of good pure gypsum are exceptional. The mineral is easily formed by the action of sulphated waters on limestone, consequently small amounts of the mineral are usual in mining regions where sulphides are decomposing. Larger deposits are generally bedded deposits formed by the evaporation of lime sulphate waters and these are apt to be quite impure from admixtures of lime carbonate and clay.

Selenite, satin spar, alabaster and *gypsite* are varietal names. The granular, bedded and efflorescent deposits are the only kind in the State of value and the term "gypsite" is generally applied to the material of such deposits.

The locations of some of the deposits are given, and the mineral is frequently mentioned in descriptions of the counties.

Hess[3] has given us a more recent description of the gypsum resources of the State.

Alpine County: Small amounts occur at Bulliana.

Butte County: Found at the St. Clair mine. A vein of gray gypsum occurs one mile from Pentz near road to Cherokee Flat.

Colusa County: Small amounts occurred with the sulphur at Sulphur Creek.

Contra Costa County: Selenite gypsum is common in the coal seams at Antioch and near Danville. Disks of selenite occur near Clayton.

Fresno County: Deposits of gypsite occur on the low hills on the north and south sides of Tomey Creek, about eighteen miles southwest of Mendota, and along Cantua Creek. In the Coalinga oil district there are frequent occurrences of gypsite. Occurs in San Joaquin mine, four miles northwest of Coalinga. Deposit west of Huron. Satin spar occurs in Oil Creek Canyon.

Imperial County: Yellow selenite has come from a locality about five miles west of Volcano. An extensive bed of gypsum associated with celestite occurs in the Fish Creek Mountains about thirty miles west of Brawley. Analysis of Fish Creek Mountain gypsum by J. O. Handy:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	H_2O
0.92	0.21	0.14	32.75	0.08	47.17	18.73

Occurs on south slope of Coyote Mountains, three miles northwest of Coyote Wells. High grade near Dixieland.

Inyo County: Fibrous gypsum occurs at Clark's Fork, Amargosa River. Small amounts occur in the Cerro Gordo district. Deposits occur between Tecopa and Acme. Satin spar occurs in long fibrous masses on Clark's Fork, Amargosa River.

Kern County: Hess[3] reports good deposits of gypsite in the Lost Hills about twenty-five miles west of Waseo. An analysis of the material was made by C. W. Wells and quoted by Hess.

CaO	SO_3	H_2O	Cl	Fe_2O_3	CO_2	SiO_2	Al_2O_3	Na_2O	K_2O	MgO	
29.5	40.7	19.1	none	0.4	0.7	5.3	1.7	1.2	0.6	--	= 99.2%
29.9	40.8	19.4	none	0.3	--	6.1	1.4	2.0	0.5	--	=100.4

Impure gypsite is common in the oil districts and some has been mined in the McKittrick district. Deposits are said to exist on Cottonwood Creek, about sixteen miles east of Bakersfield. Beds of gypsum occur in the bed of old Kern Lake, about twenty miles southwest of Bakersfield and five miles from Connor. Some gypsite occurs on the shores of Buena Vista Lake. Selenite is found with stibnite at the old San Emidio antimony mine. Small deposits of gypsite occur near Kane Springs and near Bakersfield, resting on limestone. Gypsite and gypsum occur on Mojave Desert, twelve miles east of Mojave. Found as selenite on Posa Creek. Near Kane Springs as a lake deposit.

Kings County: Gypsite occurs in deposits on the range of low hills southeast of Dudley and on Kettleman Plains, about five miles northeast of Dudley.

Lake County: Selenite is found on Robinson's ranch. Small amounts are also found at Sulphur Bank, Clear Lake.

Lassen County: Large slabs of selenite occur near Susanville. Observed at Honey Lake.

Los Angeles County: Deposits of good white gypsum occur in Charley Canyon, twelve miles north of Castiac in shale rock. Gypsite and alabaster occur at Palmdale on ridge interbedded with shales. Seams occur in bluffs at San Pedro. A deposit is given two miles north of Lang. Large selenite plates have been found in Soledad Canyon.

Mariposa County: Selenite has been reported from Bear Valley.

Mono County: Occurs in the Bodie district. Observed in mountains south of Mono Lake.

Monterey County: Deposits occur east of King City near county line.

Napa County: Small amounts of gypsum were associated with the cinnabar at the old Redington or Boston mine, Knoxville.

Nevada County: Fibrous radiate gypsum occurs near Truckee.

Orange County: Outcrops of gypsum occur in Gypsum Canyon and adjacent canyons, about two miles south of Corona. Alabaster gypsum occurs on San Joaquin Ranch.

Riverside County: Good deposits of gypsum occur in the Palen Mountains interstratified with limestone. Deposits also occur in the Santa Maria Mountains which are thought to be extensive. Some gypsum occurs in the Colorado Desert about twelve miles east of Mecca. Massive white and fine selenite crystals occur at the Adams Blakely mine. Selenite occurs south of South Riverside. Deposits occur near Banning and in the hills west and southwest of Corona. White finely crystalline gypsum occurs twenty miles southeast of Blythe.

San Benito County: Outcrops of gypsum occur along the Coast Range in many places. Many occurrences in Bitterwater Valley. Deposits lie east of Metz and King City.

San Bernardino County: In the dry lake depressions of the desert deposits of gypsite occur but most of them are impure material. A large deposit of this nature occurs at Amboy which is mined at present. Some also is found in the lake beds south of Danby and near Kelso. Gypsum is one of the associated minerals of the borax at Searles Borax Lake. Selenite occurred with colemanite in the Calico district. Large deposits of gypsum occur on the northeast side of Avawatz Mountains. Selenite, satin spar and massive white, pink, red and green occur. Selenite in good crystal specimens occurs in the colemanite beds near Yerma. A deposit occurs near Camp Cady. Thin beds are associated with rock salt in the Avawatz Mountains. Crystals occur in the mud of Strontium Hills, ten miles north of Barstow.

San Diego County: Gypsite is found near Dos Palmas.

San Francisco County: Small amounts have been found near Merced Lake. Disks of selenite occur on Seal Rock. Some selenite is found at Fort Point.

San Joaquin County: Selenite occurs at Vernalis.

San Luis Obispo County: White bunches and veins occur on Alamo Creek, sixteen miles from Santa Maria. Some alabaster occurs at Arroya Grande. Gypsite occurs in beds on the southwest side of Tremblor Range, east of Carrizo Plain. Selenite crystals occur in the clays of Carrizo Creek.

Santa Barbara County: Alabaster occurs near Santa Barbara Creek, about thirty-two miles southwest of McKittrick. Small amounts of alabaster are found on Santa Rosa Island. Massive gypsum was early

worked near Point Sal. Occurs as massive gypsum in Cuyama Canyon on east side of Santa Barbara Canyon, five miles south of Quartel.

Santa Clara County: Selenite occurs near Gilroy.

Santa Cruz County: Satin spar and massive white gypsum occur near Santa Cruz.

Shasta County: Some gypsum as hydration of anhydrite occurs in the Bully Hill and Rising Star mines.

Sierra County: Small amounts have been found on Kanaka Creek.

Siskiyou County: Massive white gypsum occurs near Sulphur Springs, Mt. Shasta.

Sonoma County: Found at the Geysers with sulphur and with boussingaultite. Selenite in good crystals has been found near Santa Rosa.

Stanislaus County: Selenite is found near Modesto.

Trinity County: Small amounts of fibrous gypsum occur at Island Mountain.

Tulare County: Fibrous satin spar at White River. Occurs twenty miles southeast of Porterville.

Tuolumne County: Some gypsum has been found near Groveland.

Ventura County: Small amounts on Dennison Ranch, three miles east of Nordhoff. Selenite occurs in Lockwood Valley. Massive white gypsum occurs four miles south of Fillmore interbedded with diatomaceous shale. Also on South Mountain about four miles south of Santa Paula. Occurs as alabaster on French Point hill six miles above mouth of Santa Barbara Canyon: Analysis of white gypsite from Ojai Valley:

$CaSO_4$	MgO	Na_2O	SiO_2	$Al_2O_3+Fe_2O_3$	H_2O
75.22	1.15	1.10	0.76	0.34	21.22 = 99.86%

355. EPSOMITE—Epsom Salts.

Hydrous sulphate of magnesium, $MgSO_4.7H_2O$.

Orthorhombic. Bunches of long slender fibers and fibrous crusts. Cleavage perfect brachypinacoidal. Color white. Vitreous luster. H=2—2.5; G=8.75. Taste bitter and salt.

Refractive indices: $\alpha=1.433$; $\beta=1.455$; $\gamma=1.461$.

Soluble in water. Barium chloride precipitates barium sulphate from a hydrochloric acid solution. Sodium phosphate added to an ammonium chloride solution precipitates white magnesium pyrophosphate.

Effloreseences of epsomite are common in caves and tunnels where pyrite or other sulphides are decomposing in the presence of magnesian rocks. Long hair-like masses of the mineral are common in the cinnabar mines of the State but no epsomite is mined. Commercial epsomite is produced as a by-product in the evaporation of the bitterns of sea water at the salt works.

Alameda County: An efflorescence on the walls of the pyrite mines of Leona Heights. Analysed from the Alma mine by Schaller[1].

MgO	SO_3	H_2O at 100°	H_2O ab. 110°	Al_2O_3	
14.8	31.7	40.8	12.2	tr.	=99.5%

Amador County: Common in the mines on Copper Hill.

Imperial County: Mentioned by Emory[1] as occurring in white crusts on the Colorado Desert.

Lake County: Abundant in the old Abbott quicksilver mine.

Mariposa County: Found as fine fibers in the Purchase mine near Donovan.

Napa County: Abundant in long white fibers in the tunnels of the old Redington mine, Knoxville.

San Benito County: Exceptionally long fibers of epsomite occur in the New Idria cinnabar mine.

Santa Clara County: Abundant on the walls of the New Almaden and other cinnabar mines of the county.

Sonoma County: An associate of boussingaultite, Goldsmith[6].

356. GOSLARITE—White Vitriol.

Hydrous sulphate of zinc, $ZnSO_4.7H_2O$.

Orthorhombic. In long acicular crystals and massive crusts. Perfect brachy pinacoidal cleavage. Brittle. Color white, reddish or bluish. Taste metallic, nauseous. H=2—2.5; G=1.9—2.1.

Refractive indices: $\alpha=1.450$; $\beta=1.481$; $\gamma=1.481$.

Yields water in closed tube. Reduced with soda on charcoal, giving yellow coating, which turns green when heated with cobalt nitrate. Barium chloride will precipitate the sulphate. Easily soluble in water.

Formed through the decomposition of sphalerite and is sometimes found on the walls of tunnels.

Trinity County: Very small amount of white powdery goslarite occurs in the decomposed material at the pyrrhotite deposit at Island Mountain.

357. MORENOSITE.

Hydrous sulphate of nickel, $NiSO_4.7H_2O$.

Orthorhombic. Acicular crystals, fibrous, efflorescent. Color apple-green to greenish white. Vitreous luster. H=2—2.5; G=2. Taste metallic.

Refractive indices: $\alpha=1.467$; $\beta=1.489$; $\gamma=1.492$.

Fused in a borax bead, gives a brown bead of nickel in the oxidizing flame, which becomes gray and cloudy in the reducing flame. Nickel can also be determined by using dimethylglyoxime. Gives off acid water in a closed tube.

Napa County: Said by Becker[1] to coat a specimen of millerite from the Phoenix cinnabar mine.

358. MELANTERITE—Copperas.

Hydrous sulphate of iron, $FeSO_4.7H_2O$.

Monoclinic. Fibrous, stalactitic. Cleavage basal. Color light green to white. Vitreous luster. H=2; G=1.89—1.9

Refractive indices: α=1.471; β=1.478; γ=1.486.

Easily soluble in water. Becomes magnetic on heating. Ammonia precipitates reddish ferric hydrate from a nitric acid solution. Barium chloride precipitates barium sulphate. Gives acid water in a closed tube.

Melanterite is a common formation in mines containing pyrite or marcasite.

Alameda County: Abundant as small fibrous crystals on the walls of the Alma pyrite mine at Leona Heights. Described and analysed by Schaller[1]. Forms: (110), (001), (010), (103), (101), (011), (111), ($\bar{1}$21), (120), (102), (203), (302), (201), (904), (332).

FeO	SO_3	H_2O	CuO	MgO	
28.1	31.2	42.0	none	none	=101.3%

Amador County: Occurred on walls of an old tunnel 1½ miles north of Volcano. Had mendozite associated with it.

Lake County: Abundant as stalactites in the Sulphur Bank cinnabar mine, Clear Lake.

Mariposa County: Found as coatings in the Purchase mine, near Donovan.

Mono County: Common in the mines about Lundy. Found with pyrite and arsenopyrite at Mono Lake.

Napa County: Long pale green stalactites were abundant in the old Redington cinnabar mine, Knoxville.

Santa Cruz County: Specimens have come from the vicinity of Santa Cruz.

Shasta County: Common at Copper City, Bully Hill and other mines of the county.

Sonoma County: Drusy green specimens have been found near Petaluma.

359. PISANITE.

Hydrous sulphate of iron and copper $(Fe.\ Cu)SO_4.7H_2O$.

Monoclinic. Long slender prisms, stalactitic. Color greenish blue. Vitreous luster. H=1—2.

Refractive indices: α=1.472; β=1.479; γ=1.487.

Reactions are similar to those for melanterite, except that ammonia turns the solution blue at the same time precipitating the iron as ferric hydrate.

Alameda County: One of the secondary sulphates formed with melanterite and chalcanthite on the walls of the Alma pyrite mine on Leona Heights. Described and analysed by Schaller[1]. Forms: (001),

(101), (010), (110), (103), (011), (100), (210), (320), (120), ($\bar{1}$01), ($\bar{1}$12), ($\bar{2}$05), (111), ($\bar{3}$35), ($\bar{2}$21), ($\bar{1}$21).

CuO	FeO	SO_3	H_2O at 110°	H_2O ab. 110°	MgO	
15.73	12.31	28.21	45.14		--	=101.39%
9.22	16.47	29.18	45.74		--	=100.61
17.95	5.46	29.25	34.25	10.96	2.82	=100.69

Monterey County: Pale blue crystals from near Gonzales were analysed by Schaller[3].

CuO	FeO	SO_3	H_2O
7.56	15.85	30.74	45.85

360. BIEBERITE—Cobalt Vitriol.

Hydrous sulphate of cobalt, $CoSO_4.7H_2O$.

Monoclinic. Stalactites and crusts. Color rose-red. Astringent taste. Soft and friable. G=1.924.

Refractive indices: α=1.447; β=1.483; γ=1.489.

Yields water in a closed tube. Gives a blue bead with borax. Sulphate is precipitated by barium chloride.

A secondary sulphate formed through the alteration of cobalt-bearing minerals. Generally formed by dessication of solutions containing it.

Trinity County: Small amount as a pale rose-red powder occurs from the dessication of the sulphate solutions at the pyrrhotite deposit near Island Mountain.

361. BOOTHITE.

Hydrous sulphate of copper, $CuSO_4.7H_2O$.

Monoclinic. Fibrous massive. Color greenish blue. Vitreous luster. H=2—2.5; G=1.94—2.1.

Soluble in water. Gives the blue solution of copper when ammonia is added to a nitric acid solution. The sulphate is determined by barium chloride. Gives water in a closed tube, which reacts acid.

Alameda County: This was a new sulphate of copper differing from chalcanthite in the amount of water and crystallization, found with the other sulphates of iron and copper at the Alma pyrite mine, Leona Heights. Described as a new mineral and named by Schaller[1]. Forms: (001), (100), (110), ($\bar{1}$01), ($\bar{3}$01), ($\bar{1}$12), ($\bar{1}$11), ($\bar{1}$21).

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	
27.83	tr.	--	28.37	36.64	7.42	=100.26%
28.53	0.28	tr.	28.65	43.76		=101.26

Calaveras County: Crystals of this new sulphate were later found at Campo Seco and analysed by Schaller[3].

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	Insol.	
26.13	0.81	0.64	27.25	36.76	4.91	3.96	=100.46%

362. CHALCANTHITE—Blue Vitriol—Bluestone.

Hydrous sulphate of copper, $CuSO_4.5H_2O$.

Triclinic. Generally in fibrous veins or stalactitic. Color greenish blue to sky-blue. Vitreous luster. H=2.5; G=2.12—2.3.

Refractive indices: $\alpha=1.516$; $\beta=1.539$; $\gamma=1.546$.

Same reactions as for boothite and only distinguishable by amount of water.

The natural chalcanthite is found in mines where it results from the alteration of copper sulphides but the amount is generally small and unimportant. All of the commercial bluestone is a manufactured product.

Alameda County: It is common in small crystals and seams in the Alma pyrite mine, Leona Heights, and was described and analysed by Schaller[1]. Forms: (001), (010), (100), (110). (120), (1$\bar{1}$0), (1$\bar{2}$0), (011), (0$\bar{2}$1), (0$\bar{3}$1), ($\bar{1}$01), ($\bar{1}$11), ($\bar{1}\bar{3}$1), (1$\bar{4}$1).

CuO	FeO	MgO	SO_3	H_2O at 110°	H_2O ab. 110°	Insol.	
31.14	none	tr.	32.06	28.20	7.50	0.81	=99.71%

Amador County: Common in the mines on Copper Hill.

Calaveras County: Occurred at Quail Hill, Silliman[5]. Common at Copperopolis.

Nevada County: Found at Sweetland, Hanks[6].

Shasta County: Common evaporation product in the mines of the county and reported from the Peck mine, Copper City, Hanks[6]. Bluish green crystals and veins have been observed at Copper City.

363. BLÖDITE.

Hydrous sulphate of magnesium and sodium, $MgSO_4.Na_2SO_4.4H_2O$.

Monoclinic. Prismatic crystals, granular massive. Color white. Vitreous luster. Soft. G=1.67.

Refractive indices: $\alpha=1.486$; $\beta=1.488$; $\gamma=1.489$.

Easily soluble in water. Barium chloride precipitates barium sulphate from an acid solution. Fuses, giving a strong yellow flame. Magnesia is determined by precipitation with sodium phosphate from an ammonia solution. Gives water in a closed tube.

Imperial County: Specimens of this rare sulphate are reported to have been found on the Colorado Desert.

San Luis Obispo County: Very large crystals of blödite occur in the mud of Soda Lake, Carisso Plains, which have been described by Schaller [13]. They show the following forms: (001), (110), (210), (011), (111), ($\bar{2}$01), ($\bar{1}$11), ($\bar{2}$11), ($\bar{1}$21).

Analysis:

Na_2O	MgO	SO_3	H_2O	
18.26	11.93	48.11	21.37	=99.67%

364. BOUSSINGAULTITE.

Hydrous sulphate of ammonium and magnesium $(NH_4)_2SO_4.MgSO_4.6H_2O$.

Monoclinic? Fibers, crusts, vermiform aggregates and stalactites. Color pure white. Silky luster. Taste saline-astringent. H=2; G=1.68—1.72.

Refractive indices: $\alpha = 1.470$; $\beta = 1.472$; $\gamma = 1.479$.

Easily fusible, and easily soluble in water. Barium chloride precipitates barium sulphate, and sodium phosphate precipitates the magnesia. Gives water in a closed tube. Heated in closed tube with lime, it gives odor of ammonia.

Sonoma County: This rare sulphate was described and analysed by Goldsmith[6]. No locality was given, but presumably it came from the vicinity of the Geysers.

SO_3	MgO	NH_4OH	H_2O
38.86	15.56	5.03	40.55

Ventura County: Found on South Mountain opposite Santa Paula, in stalactites and incrustations, formed by heated gases escaping through crevices in sandstone and shale. Described by Larsen and Shannon[1]. Analysis by Shannon:

$(NH_4)_2O$	MgO	Al_2O_3	Fe_2O_3	K_2O	Na_2O	CaO	SO_3	H_2O	Cl	CO_2	
10.86	11.54	0.04	0.08	0.22	0.60	tr.	43.49	31.48	tr.	tr.	= 98.31%

365. KALINITE—Potash Alum—Common Alum.

Hydrous sulphate of aluminium and potassium, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Mealy crusts and fine fibrous. Color white. Vitreous luster. H=2—2.5; G=1.75. Alum taste.

Refractive index: $n = 1.456$.

Easily soluble in water. Ammonia precipitates flocculent alumina hydrate, and barium chloride precipitates barium sulphate from a hydrochloric acid solution. Gives the violet flame of potassium when fused on platinum wire. Yields much water in a closed tube.

Mealy crusts of alum are rather common in mining regions, formed by the action of sulphated waters on rocks, and are more prominent in association with gypsum deposits. There are several kinds of alum, but the various species have not in general been differentiated. Commercial alum is largely a manufactured product.

Alpine County: Found at the mines of Silver Mountain.

Calaveras County: Observed at Quail Hill, Silliman[5].

Fresno County: Common in the oil district at Coalinga with sulphur.

Inyo County: Occurs on the shores of Owens Lake. Also on the sides of a steaming vent two miles east of Coso Springs, as white crusts, Rogers[5].

Lake County: Common at the Sulphur Bank cinnabar mine.

Los Angeles County: Occurs near Newhall.

Mono County: Found near Bodie.

Napa County: Observed at the Redington cinnabar mine, Knoxville, Melville and Lindgren[1].

Placer County: In the gold mines near Dutch Flat; in slates near Auburn.

San Bernardino County: Some granular kalinite has come from this county.

Sonoma County: Found at the Geysers.

366. TSCHERMIGITE—Ammonium Alum.

Hydrous sulphate of aluminium and ammonium, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.

Isometric. Octahedral crystals, fibrous, crusts. Color white. Vitreous luster. H=1—2; G=1.5.

Refractive index: $n=1.459$.

Heated in a closed tube with lime, it gives off odor of ammonia. Barium chloride precipitates barium sulphate from a hydrochloric acid solution. Ammonia precipitates alumina. Gives water in a closed tube. Soluble in water.

Lake County: Mentioned by Becker[1] as an efflorescence at Sulphur Bank.

367. MENDOZITE—Soda Alum.

Hydrous sulphate of aluminium and sodium, $Na_2SO_4.Al_2(SO_4)_3.24H_2O$.

White fibrous masses or powder. H=3; G=1.88.

Refractive indices: $\alpha=1.432$; $\beta=1.457$; $\gamma=1.463$.

Gives strong yellow flame. Reactions similar to other alums.

There are many varieties of alums, all formed as secondary minerals, by crystallization from sulphate solutions.

Amador County: Crusts on walls of old tunnel 1½ miles north of Volcano, associated with melanterite.

Inyo County: Some soda alum has been found in the Panamints.

Napa County: Occurs on Pritchard Ranch, nine miles southeast of St. Helena.

San Bernardino County: Platy and fibrous, white mendozite occurs five miles north of Hidden Springs.

368. PICKERINGITE—Magnesia Alum.

Hydrous sulphate of aluminium and magnesium. $MgSO_4.Al_2(SO_4)_3.22H_2O$.

Monoclinic. Fine acicular crystals as efflorescences. Color white, yellowish and pink. Luster silky. H=1. Taste bitter, astringent.

Refractive indices: $\alpha=1.476$; $\beta=1.480$; $\gamma=1.483$.

Yields water in closed tube. Alumina and magnesia can be precipitated from acidified solution by ammonia and sodium phosphate.

One of the alums having the usual alum taste. Found as efflorescences on shale containing pyrite.

Inyo County: Reported as a secondary efflorescene in the mountains west of Bishop.

369. HALOTRICHITE—Iron Alum.

Hydrous sulphate of aluminium and iron, $FeSO_4.Al_2(SO_4)_3.24H_2O$. Monoclinic? Silky fibrous. Color yellowish white. Ink taste.

Refractive index: $\beta = 1.49$.

Ammonia precipitates iron and alumina from a hydrochloric acid solution. Barium chloride precipitates barium sulphate. Gives much water in a closed tube. Soluble in water.

Alameda County: Found as fibrous masses in the Eureka tunnel, near Livermore.

370. SONOMAITE—Magnesia Alum.

Hydrous sulphate of aluminium and magnesium, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.

Colorless crystals. Silky luster. G=1.60.

Ammonia added to a hydrochloric acid solution precipitates alumina and sodium phosphate added to the filtrate throws down magnesia. Barium chloride precipitates barium sulphate. Much water is obtained in a closed tube.

Sonoma County: This alum was described as a new mineral from this county by Goldsmith(5). No locality was given.

Al_2O_3	FeO	MgO	SO_3	H_2O
7.66	2.01	7.14	38.78	44.41
8.36	1.56	7.51	38.30	44.27

371. COQUIMBITE.

Hydrous sulphate of iron, $Fe_2(SO_4)_3.9H_2O$.

Hexagonal, rhombohedral. Generally granular massive. Color yellowish, brownish, greenish or violet. Vitreous luster. H=2—2.5; G=2.09.

Refractive indices: $\epsilon = 1.556$; $\omega = 1.550$.

Soluble in water and has an astringent taste. Becomes magnetic on heating; barium chloride precipitates barium sulphate. Gives water in closed tube.

Calaveras County: Mentioned as one of the minerals formed at Quail Hill by Silliman(5).

El Dorado County: Occurs in the shales near Georgetown.

Inyo County: Yellow crystals have been found at Lone Pine.

Napa County: Large masses of yellowish green, granular coquimbite occur at the old Redington cinnabar mine. The mineral was described by Eakle(1) with analysis by Schaller.

Fe_2O_3	Al_2O_3	SO_3	H_2O at 100°	H_2O ab. 100°	FeO	SiO_2	Na_2O	MgO	
12.99	7.44	38.04	23.72	13.71	0.13	0.21	1.68	1.09	=99.04%

Tuolumne County: Silliman(5) mentions it as one of the minerals at Whiskey Hill.

372. ALUNOGEN.

Hydrous sulphate of aluminium, $Al_2(SO_4)_3.18H_2O$.

Monoclinic. Fibrous masses, crusts, powder. Color white. Vitreous to silky luster. H=1.5—2; G=1.6—1.8. Alum taste.

Refractive indices: $\alpha=1.473$; $\beta=1.474$; $\gamma=1.480$.

Soluble in water and has an alum taste. Ammonia precipitates alumina hydroxide; barium chloride precipitates barium sulphate. In a closed tube gives water.

Alameda County: Occurs as a white powder at the Alma mine, Leona Heights, Schaller[1].

Nevada County: Observed at the Providence mine, Nevada City, Lindgren[6].

San Luis Obispo County: Found as a white powder near Paso Robles.

373. RÖMERITE.

Hydrous sulphate of iron, $Fe_2(SO_4)_3.12H_2O$.

Triclinic. Tabular crystals and granular. Perfect brachypinacoidal cleavage. Brittle. Color dark brown. Taste saline, astringent. H=3—3.5; G=2.174.

Refractive indices: $\alpha=1.524$; $\beta=1.571$; $\gamma=1.583$.

Easily soluble in water. Becomes magnetic on heating. Barium chloride precipitates barium sulphate.

Formed as a secondary mineral in the alteration of pyrrhotite.

Trinity County: Small brown crystals forming friable masses occur in the decomposed material from the pyrrhotite deposit at Island Mountain.

374. COPIAPITE.

Hydrous sulphate of iron, $2Fe_2O_3.5SO_3.18H_2O$.

Monoclinic. Scaly massive, incrustations. Color sulphur-yellow. Pearly luster. H=2.5; G=2.10.

Refractive indices: $\alpha=1.507$; $\beta=1.529$; $\gamma=1.573$.

Similar to coquimbite in its reactions.

Alameda County: Found as yellow needles at the Alma mine, Leona Heights, and analysed by Schaller[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O	Insol.	
38.36	0.31	25.04	0.44	0.29	29.71	5.43	=99.58%

Lake County: Occurs at Sulphur Bank and analysed by Melville and Lindgren[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Insol.	
38.82	0.37	26.79	3.28	tr.	0.25	0.16	29.58	0.75	=100.00%

Napa County: Found at the old Redington mine, Knoxville, and analysed by Melville and Lindgren[1].

SO_3	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	
39.97	--	26.54	0.46	0.21	--	3.06	30.43	=100.67%

Riverside County: Found near Blythe.

375. KNOXVILLITE.

Hydrous basic sulphate of iron, chromium, aluminium, nickel and magnesium.

Orthorhombic. Tabular crystals. Color greenish yellow. Cleavage perfect basal. Vitreous luster.

Refractive indices: $\alpha = 1.507$; $\beta = 1.529$; $\gamma = 1.576$.

Soluble in water. Becomes magnetic on heating. May give a chromium bead when fused with borax. Barium chloride precipitates barium sulphate. Gives water in a closed tube.

Napa County: Greenish yellow masses of this complex sulphate were found in the old Redington mine, Knoxville, and the mineral was described as new by Melville and Lindgren[1]. Forms: (001), (110), (100). Crystals are basal plates.

SO_3	Fe_2O_3	Cr_2O_3	Al_2O_3	FeO	NiO	MgO	H_2O at 100°	H_2O ab. 100°	Insol.
35.91	15.36	7.41	4.84	3.81	0.83	3.22	9.29	17.59	1.74

376. REDINGTONITE.

Hydrous sulphate of chromium, aluminium, iron and magnesium.

Finely fibrous to granular massive. Color pale purple. Silky luster. G = 1.76.

Reactions are similar to those for knoxvillite.

Napa County: A pale purple sulphate was mixed with the knoxvillite from the Redington mine which was described as a new mineral by Melville and Lindgren[1].

SO_3	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	NiO	MnO	H_2O at 100°	H_2O ab. 100°	Insol.		
35.35	5.14	7.51	0.19	4.58	1.00	tr.	1.85	27.09	14.34	3.46	= 100.51%

377. FIBROFERRITE.

Hydrous sulphate of iron, $Fe_2O_3(SO_3)_2.10H_2O$.

Orthorhombic? Fine fibrous aggregates. Color pale yellow to white. Luster silky. H = 2—2.5; G = 1.84.

Refractive indices: $\alpha = 1.533$; $\beta = 1.534$; $\gamma = 1.575$.

Becomes magnetic on heating. Soluble in water. Barium chloride precipitates barium sulphate.

Formed by the decomposition of iron sulphides such as pyrrhotite.

Trinity County: Fibrous aggregate of yellow fibroferrite have formed from the sulphate solutions at the pyrrhotite deposit at Island Mountain.

378. BOTRYOGEN—Palacheite.

Hydrous sulphate of iron and magnesium, $Fe_2O_3.2MgO.4SO_3.15H_2O$.

Monoclinic. Very small crystals. Color brick-red, hyacinth-red. Vitreous luster. H = 2—2.5; G = 2.04—2.14.

Refractive indices: $\alpha = 1.544$; $\beta = 1.548$; $\gamma = 1.572$.

Partly soluble in water. Becomes magnetic on heating. Presence of magnesia distinguishes it from other iron sulphates.

Napa County: Found in bunches of small brick-red crystals in one of the tunnels of the old Redington mine, Knoxville. It was thought to

by a new mineral and described and named "palacheite" by Eakle [3]. Its identity with botryogen was later established, Eakle[4] Forms: (110), (010), (001), (120), (450), (021), ($\bar{2}$01), ($\bar{1}$11), ($\bar{1}$21).

Fe_2O_3	MgO	SO_3	H_2O at 100°	H_2O ab. 100°	
19.51	9.36	38.37	19.53	12.75	=99.51%

379. ALUNITE.

Hydrous sulphate of aluminium and potassium, $K_2O.3Al_2O_3.4SO_3.6H_2O$.

Hexagonal, rhombohedral. Small crystals and massive. Color white. Vitreous luster. H=3.5 — 4; G=2.58 — 2.75.

Refractive indices: ϵ=1.592; ω=1.572.

Slowly soluble in sulphuric but insoluble in hydrochloric acid. Infusible and decrepitates. Turns blue when moistened with cobalt nitrate and intensely heated. Gives water in closed tube.

Colusa County: Alunite carrying gold has been found at Sulphur Creek.

Mariposa County: Alunite is a constituent of a quartzite rock found with a greenstone schist in which stellate pyrophyllite occurs, at the Tres Cerritos, southwest of Indian Gulch. Described by Turner[4][5], with analysis by Valentine.

SO_3	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	SiO_2	TiO_2
38.50	38.05	0.23	0.55	tr.	4.48	2.78	11.92	2.64	0.40

P_2O_5		
tr.	=99.55%	Sp. G.=2.78

380. JAROSITE.

Hydrous sulphate of potassium and iron, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

Hexagonal, rhombohedral. Small platy crystals, fibrous, granular. Color yellowish brown. Streak yellow. Vitreous luster. H=2.5—3.5; G=3.15 — 3.26.

Refractive indices: α=1.715; β=1.817; γ=1.820.

Only partially soluble in cold water, otherwise like coquimbite in its reactions.

Kern County: Micaceous flakes of jarosite have come from this county.

San Benito County: Flakes of jarosite occur at New Idria.

381. DURDENITE.

Hydrous tellurite of iron, $Fe_2(TeO_3)_3.4H_2O$.

Massive. Spherulitic. Pale greenish-yellow color. H=2—2.5.

Refractive indices: α=1.702; β=1.955; γ=1.965.

A very rare mineral only known from one locality outside of California.

Calaveras County: A specimen of telluride ore from this county, presumably from Carson Hill, contained along its fractures pale greenish-yellow spherulites which proved to be durdenite from an optical examination by Larsen[11].

HYDROCARBONS.

Napalite	Petroleum
Ionite	Bitumen
Aragotite	Asphalt
Posepnyte	Gilsonite
Bernardinite	Grahamite
	Coal

The hydrocarbon series of chemical compounds include a number of substances occurring in nature, of a coal-like, pitch-like or oil-like structure, which are almost wholly of organic origin. Many of them are separable into a series of different hydrocarbons in varying proportions, thus showing their chemical composition to be quite indefinite. They have no place in a mineral classification, yet their occurrence as natural products in the earth, and the great economic importance of some of them, have been the reasons for their adoption in some works on mineralogy. They belong to the province of organic chemistry.

The two most valuable members of the hydrocarbon series are coal and oil. Coal is pretty generally scattered in the State, but its occurrence is in thin seams which are not segregated sufficiently to form good workable deposits. The coal is of the lignite variety, and black and brown masses of this lignite are occasionally present in the sandstones and limestones. Practically all of the coal used in California is imported.

The lack of coal is more than counterbalanced by the abundance of petroleum. California has one of the greatest oil fields in the world. The oil sands occur at various depths and are of varying thickness and produce oils of greatly diversified character and gravity. The thick series of Miocene shales and sandstones represented by the Monterey formation are the great repository and source of most of the oil of the State.

NAPALITE.

Simple hydrocarbon, C_3H_4.

A dark reddish brown bituminous substance found with cinnabar. Brittle. H=2.

Napa County: Observed at the old Phoenix cinnabar mine, Pope Valley, and was described by Becker[1], with analyses by Melville.

C	H	
89.84	10.17	=100.01%
89.54	10.36	= 99.90
89.33	10.11	= 99.46

IONITE.

A fossil hydrocarbon of earthy texture and brownish yellow color. G=0.90.

Amador County: Found in an argillaceous lignite in thin seams in Ione Valley and described by Purnell[1]. Contains about 50 per cent water and resembles pyropissite.

ARAGOTITE.

Volatile hydrocarbon.

A hydrocarbon occurring in bright yellow scales at some of the cinnabar mines.

Napa County: Occurred on the cinnabar at the Redington mine, Knoxville, Bertrand[1].

Santa Clara County: First observed at the New Almaden mine impregnating a silicious dolomite and was described by Durand[2].

POSEPNYTE.

Lake County: Plates and nodules of a dirty green and brown oxygenated hydrocarbon were found at the Great Western mine and the substance was described by von Schrockinger[1], with analyses by Dietrich. Part was soluble in ether and part insoluble, the latter corresponding to ozocerite. Becker[1] gives an analysis by Melville of similar material.

	Sol.			Insol.			
	C	H	O	C	H	O	Ash
von Schrockinger	71.84	9.95	18.21	84.27	11.74	3.99	
Melville	----	---	----	83.60	10.71	3.22	0.47

BERNARDINITE.

A substance supposed to be a fossil resin, found as a white porous mass at Santa Ana, San Bernardino County, was described as a new mineral by Stillman[1]. Considered by Brown[1] to be a fungous growth and not a mineral.

PETROLEUM—MINERAL OIL.

The presence of oil in the State has been known by seepages and other indications for many years and some districts have had producing wells for a long time, but the great oil resources of California have only been developed within the past decade, and new fields are constantly being added to the oil areas. The large productive fields are all located in the southern counties, Coalinga, in Fresno County, being the most northerly one. Oil is known to occur, however, in some of the northern

counties, but so far the areas have not been very productive. Much difference exists in the oil. Some of it is heavy, thick and black with low gravity, while other wells in the same field produce thin, easily flowing, light, high gravity oils. The Monterey shales and sandstones are the source of a large part of the oil in the State.

It is manifestly beyond the scope of this book to give a description of the numerous oil fields within the borders of California.

The Coalinga district in Fresno and Kings counties, the Kern River, and the McKittrick-Sunset districts in Kern County, the Santa Maria and Summerland fields in Santa Barbara County, the Santa Clara field in Ventura County, and the Los Angeles field are the most important fields in the State. Oil is known to exist in several counties in the northern part of the State, but very little oil has been obtained from any of the northern fields.

The geology of the oil fields has been studied by Arnold, Eldridge, Anderson and others of the United States Geological Survey, and their results published in bulletins of the Survey.

BITUMEN—ASPHALT—PITCH—TAR.

The San Pablo and Monterey formations are especially characterized by the bituminous matter which accompanies the shales and sandstones; consequently layers of bitumen and seepages of viscous tar-like matter are common in districts where these shales are exposed. They are especially prominent in the southern counties and some asphalt lakes have formed. The most noted asphalt deposit in the State is on the Rancho de la Brea in Los Angeles County. This deposit served as a trap for the capture of many animals and birds now extinct. The deposit was for a time worked for the asphalt.

Gilsonite or *uintahite* is a variety of asphalt of a brilliant black color. Has been found in Santa Barbara County.

Grahamite is also a pitch-black brilliant-lustered asphalt. Believed to be associated with cinnabar in the Great Eastern mine, Sonoma county, Bradley[3].

COAL—LIGNITE.

All of the coal of the State is of the soft lignite variety and only occurs in unimportant deposits. Many of the counties can show some seams of coal, and specimens are on exhibition in many of the county exhibits, as well as in the museum of the State Mining Bureau.

CHAPTER XII.

MINERALS ARRANGED ACCORDING TO THE ELEMENTS.

Every element which enters into the composition of minerals probably occurs in California. It is true that several rare elements like cæsium, gallium, indium and some members of the cerium-yttrium and radium groups have never been detected, but minerals occur in which these elements are usually found, so their presence may yet be revealed when more extensive chemical and spectroscopical analyses of the minerals and rocks have been made.

California is ideal in having passed through all those stages of geologic development which govern the formation of the various species or classes of minerals of igneous, metamorphic and sedimentary genesis, and in possessing the climatic conditions essential to the formation and preservation of unusual mineral species.

Five minerals of commercial importance which are not of world-wide distribution are pre-eminent in California, namely colemanite, cinnabar, magnesite, pink tourmaline and trona.

ALUMINIUM.

Corundum, Al_2O_3.
Spinel, $MgO.Al_2O_3$.
Chrysoberyl, $BeAl_2O_4$.
Bauxite, $Al_2O_3.2H_2O$.
Dawsonite, $Na_3Al(CO_3)_3.2Al(OH)_3$.
Orthoclase, $KAlSi_3O_8$.
Microcline, $KAlSi_3O_8$.
Anorthoclase, $(K,Na)AlSi_3O_8$.
Albite, $NaAlSi_3O_8$.
Oligoclase, Andesine, Labradorite, Bytownite, $m.NaAlSi_3O_8 + n\ CaAl_2Si_2O_8$.
Anorthite, $CaAl_2Si_2O_8$.
Spodumene, $LiAl(SiO_3)_2$.
Hornblende, $Ca,Mg,Fe,Al.SiO_3$.
Glaucophane, $NaAl(SiO_3)_2.(Fe,Mg)SiO_3$.
Beryl, $Be_3Al_2Si_6O_{18}$.
Nepheline, $K_2Na_6Al_8Si_9O_{34}$.
Sodalite $3NaAlSiO_4.NaCl$.
Noselite, $Na(NaSO_4.Al)Al_2(SiO)_3$.
Lazurite, $Na_8(NaS_3.Al)Al_2(SiO_4)_3$.
Grossularite, $Ca_3Al_2Si_3O_{12}$.
Pyrope, $Mg_3Al_2Si_3O_{12}$.
Almandite, $Fe_3Al_2Si_3O_{12}$.
Spessartite, $Mn_3Al_2Si_3O_{12}$.
Wernerite, $Ca,Na,Al,Cl.SiO_4$.
Gehlenite, $Ca_3Al_2Si_2O_9$.
Vesuvianite, $H_4Ca_{12}(Al,Fe)_6Si_{10}O_{42}$.
Topaz, $Al(O.F_2)AlSiO_4$.
Andalusite, Al_2SiO_5.
Sillimanite, Al_2SiO_5.
Cyanite, Al_2SiO_5.
Zoisite, $HCa_2Al_3Si_3O_{13}$.
Epidote, $HCa_2(Al,Fe)_3Si_3O_{13}$.
Allanite, $(Ca,Di,La)Ca,Fe,Al,SiO_4$.
Piedmontite, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Prehnite, $H_2Ca_2Al_2Si_3O_{12}$.
Lawsonite, $H_4CaAl_2Si_2O_{10}$.
Tourmaline, Li,Fe,Mg,B,Al,SiO_3.
Dumortierite, H, $Al_3BSi_3O_{20}$.
Muscovite, $(H,K)AlSiO_4$.
Mariposite, $(H,K)(Al,Cr)SiO_4$.
Paragonite, $H_2NaAl_3Si_2O_{12}$.
Lepidolite, $(K,Li)Al(OH.F)Al(SiO_3)_3$.
Phlogopite, $H_2KMg_3Al(SiO_4)_3$.
Biotite, $(H,K)_2(Mg.Fe)_4(Al,Fe)_2Si_4O_{16}$.
Roscoelite, $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{32}$.
Margarite, $H_2Ca_2Al_4Si_3O_{12}$.
Xanthophyllite, $H_8(Mg,Ca)_{14}Al_{16}Si_5O_{52}$.
Chloritoid, $H_2(Fe.Mg)Al_2SiO_7$.

ALUMINIUM—Continued.

Ottrelite, $H_2(Fe,Mn)Al_2Si_2O_9$.
Clinochlore, $H_8Mg_5Al_2Si_3O_{18}$.
Penninite, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.
Prochlorite, H,Mg,Fe,Al,SiO_2.
Corundophyllite, H,Mg,Al,SiO_2.
Griffithite, H, Ca,Mg,Al,Fe,SiO_2.
Chalcodite, H,Fe,Mg,Al,SiO_2.
Jefferisite, H,Mg,Fe,Al,SiO_2.
Heulandite, $H_4CaAl_2(SiO_3)_6.3H_2O$.
Phillipsite, $(K_2,Ca)Al_2Si_4O_{12}.4H_2O$.
Laumontite, $H_4CaAl_2Si_4O_{14}2H_2O$.
Stilbite, $H_4(Na_2,Ca)Al_2Si_6O_{18}.4H_2O$.
Chabazite, $(Ca,Na_2)Al_2Si_4O_{12}6H_2O$.
Analcite, $NaAlSi_2O_6.H_2O$.
Natrolite, $Na_2Al_2Si_3O_{10}.2H_2O$.
Mesolite, Na,Ca,Al,$SiO_3.H_2O$.
Thomsonite $(Na_2Ca)Al_2Si_2O_8.2\frac{1}{2}H_2O$.
Ganophyllite, $7MnO.Al_2O_3.8SiO_2.6H_2O$.
Plazolite, $3CaO.Al_2O_3.2(SiO_2,CO_2).2H_2O$.
Pyrophyllite, $H_2Al_2Si_4O_{12}$.
Kaolinite, $Al_2O_3.2SiO_2.H_2O$.
Halloysite, $H_4Al_2Si_2O_9.H_2O$.
Montmorillonite, $H_2Al_2Si_4O_{12}.nH_2O$.
Allophane, $Al_2SiO_5.5H_2O$.
Rectorite, $Al_2O_3.2SiO_2.H_2O$.
Cimolite, $2Al_2O_3.9SiO_2.6H_2O$.
Pilolite, Ca,Al,$SiO_2.H_2O$.
Amblygonite, $Li(AlF)PO_4$.
Turquois, $AlPO_4.Al(OH)_3$.
Lazulite, $(Fe,Mg)Al_2(OH)_2P_2O_8$.
Variscite, $AlPO_4.2H_2O$.
Plumbogummite, $PbO,2Al_2O_3.P_2O_5.H_2O$.
Liroconite, Cu,Al,$As_2O_5.H_2O$.
Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.
Tschermigite, $(NH_4)_2SO_4Al_2(SO_4)_3$. $24H_2O$.
Mendozite, $Na_2SO_4Al_2(SO_4)_3.24H_2O$.
Pickeringite, $MgSO_4.Al(SO_4)_3.22H_2O$.
Halotrichite, $FeSO_4.Al_2(SO_4)_3.24H_2O$.
Sonomaite, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.
Alunogen, $Al_2(SO_4)_3.18H_2O$.
Knoxvillite, Fe,Cr,Al,$SO_3.H_2O$.
Redingtonite, Fe,Cr,Al,$SO_3.H_2O$.
Alunite, $K_2O.3Al_2O_3.4SO_3.6H_2O$.

ANTIMONY.

Native antimony, Sb.
Stibnite, Sb_2S_3.
Kermesite, Sb_2S_2O.
Nagyagite, $Au_2Pb_{14}Sb_8Te_3S_{17}$.
Berthierite, $FeSb_2S_4$.
Jamesonite, $Pb_2Sb_2S_5$.
Bournonite, $(Pb,Cu_2)_3Sb_2S_6$.
Miargyrite, $AgSbS_2$.
Pyrargyrite, $Ag_3Sb_2S_3$.
Tetrahedrite, $Cu_8Sb_2S_7$.
Geocronite, $Pb_5Sb_2S_8$.
Stephanite, Ag_5SbS_4.
Polybasite, Ag_9SbS_6.
Cervantite, Sb_2O_3.
Stibiconite, $Sb_2O_4.H_2O$.
Stibioferrite, $Sb_2O_5.Fe_4O_3.H_2O$.
Stibiotantalite, $m(SbO)_2Nb_2O_8 + n(SbO)_2Ta_2O_8$.
Bindheimite, $Pb_3Sb_2O_8.4H_2O$.
Partzite, Sb, Cu, O, H_2O.

ARSENIC.

Native arsenic, As.
Realgar, AsS.
Orpiment, As_2S_3.
Cobaltite, CoAsS.
Arsenopyrite, FeAsS.
Niccolite, NiAs.
Smaltite, $CoAs_2$.
Löllingite, $FeAs_2$.
Dufrenoysite, $Pb_2As_2S_5$.
Proustite, Ag_3AsS_3.
Enargite, Cu_3AsS_4.
Arsenolite, As_2O_3.
Claudetite, As_2O_3.
Mimetite, $(PbCl)Pb_4(AsO_4)_3$.
Erythrite, $Co_3As_2O_8.8H_2O$.
Annabergite, $Ni_3As_2O_8.8H_2O$.
Scorodite, $FeAsO_4.2H_2O$.
Liroconite, Cu,Al,As_2O,H_2O.
Pittieite, Fe,As_2O_5,Fe,SO_4,H_2O.

BARIUM.

Witherite, $BaCO_3$.
Benitoite, $BaTiSi_3O_6$.
Volborthite $(Cu,Ca,Ba)_3(OH)_3VO_4.6H_2O$.
Barite, $BaSO_4$.

BERYLLIUM.

Chrysoberyl, $BeAl_2O_4$.

Beryl, $Be_3Al_2Si_6O_{18}$.

BISMUTH.

Native Bismuth, Bi.
Bismuthinite, Bi_2S_3.
Tetradymite, Bi_2Te.
Bismite, Bi_2O_3.
Bismutosphaerite, Bi_2CO_5.
Bismutite, $Bi_2CO_5.H_2O$.

BORON.

Sassolite, $B_2O_3.3H_2O$.
Datolite, $HCaBSiO_5$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Tourmaline, Li,Fe,Mg,B,SiO_2.
Dumortierite, $HAl_8BSi_3O_{20}$.
Searlesite, $NaB(SiO_3)_2.H_2O$.
Ludwigite, $3MgO.B_2O_3.FeOFe_2O_3$.
Vonsenite, $2(Fe,Mg)O.B_2O_3.FeO.Fe_2O_3$.
Borax, $Na_2B_4O_7.10H_2O$.
Colemanite, $Ca_2B_6O_{11}.5H_2O$.
Priceite, $5CaO.6B_2O_3.9H_2O$.
Meyerhofferite, $2CaO.3B_2O_3.7H_2O$.
Inyoite, $2CaO.3B_2O_3.9H_2O$.
Ulexite, $NaCaB_5O_9.8H_2O$.
Hydroboracite, $CaMgB_6O_{11}.6H_2O$.
Bakerite, $8CaO.5B_2O_5.6SiO_2.6H_2O$.
Howlite, $H_5Ca_2B_5SiO_{14}$.

BROMINE.

Embolite, Ag(Br,Cl).

CADMIUM.

Greenockite, CdS.

CALCIUM.

Fluorite, CaF_2.
Calcite, $CaCO_3$.
Limestone.
Marble.
Dolomite, $(CaMg)CO_3$.
Ankerite, $CaCO_3.MgCO_3.FeCO_3$.
Aragonite, $CaCO_3$.
Gay-Lussite, $CaCO_3.Na_2CO_3.5H_2O$.
Pirssonite, $CaCO_3.Na_2CO_3.2H_2O$.
Oligoclase, Andesine, Labradorite, Bytownite, $m NaAlSi_3O_8 + n CaAl_2Si_2O_8$.
Anorthite, $CaAl_2Si_2O_8$.
Pyroxene, $Ca(Mg,Fe)(SiO_3)_2$.
Wollastonite, $CaSiO_3$.
Pectolite, $HNaCa_2(SiO_3)_2$.
Amphibole, $Ca(Mg,Fe)_3(SiO_3)_4$.
Grossularite, $Ca_3Al_2(SiO_4)_3$.
Andradite, $Ca_3Fe_2(SiO_4)_3$.
Uvarovite, $Ca_3Cr_2(SiO_4)_3$.
Monticellite, $CaMgSiO_4$.
Iddingsite, Fe,Mg,Ca,Na, Silicate.
Wernerite, $Ca_4Al_6Si_6O_{25} + Na_4Al_3Si_9O_{24}Cl$.
Gehlenite, $Ca_3Al_2Si_2O_9$.
Merwinite, $Ca_3Mg(SiO_4)_2$.
Vesuvianite, $H_4Ca_{12}(Al,Fe)_6Si_{10}O_{43}$.
Spurrite, $2CaSiO_4.CaCO_3$.
Datolite, $HCaBSiO_5$.
Zoisite, $HCa_2Al_3Si_3O_{13}$.
Epidote, $HCa_2(Al,Fe)_3Si_3O_{13}$.
Allanite, (Ce,Di,La)Ca,Fe,Al,Silicate.
Piedmontite, $HCa_2(Al,Mn,Fe)Si_3O_{13}$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Prehnite, $H_2Ca_2Al_2Si_3O_{12}$.
Uvaite, $CaFe_2(FeOH)Si_2O_8$.
Lawsonite, $H_4CaAl_2Si_2O_{10}$.
Margarite, $H_2CaAl_4Si_2O_{12}$.
Xanthophyllite, $H_8(Mg,Ca)_{12}Al_{16}Si_5O_{52}$.
Griffithite, $H_4(Mg,Fe,Ca)_4(Al,Fe)_2Si_3O_{19} 5H_2O$.
Heulandite, $H_4CaAl_2(SiO_3)_6.3H_2O$.
Phillipsite, $(K_2,Ca)Al_2(SiO_3)_4.4H_2O$.
Laumontite, $H_4CaAl_2Si_4O_{14}.2H_2O$.
Stilbite, $H_4(Na_2,Ca)Al_2Si_6O_{13}.4H_2O$.
Chabazite, $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.
Mesolite, $(Ca,Na_2)Al_2Si_3O_{10}.2H_2O$.
Thomsonite, $(Na_2,Ca)Al_2Si_2O_8.2\frac{1}{2}H_2O$.
Gyrolite, $H_2Ca_2Si_3O_9.H_2O$.
Jurupaite, $H_2(Ca,Mg)_2Si_2O_7$.

CALCIUM—Continued.

Apophyllite, $H_7KCa_4(SiO_3)_8.4\frac{1}{2}H_2O$.
Eakleite, $H_2Ca_5Si_3O_{16}$.
Okenite, $H_2CaSi_2O_6.H_2O$.
Inesite, $2(Mn,Ca)SiO_3.H_2O$.
Crestmoreite, H_2CaSiO_4.
Riversideite, $Ca_2Si_2O_6.H_2O$.
Plazolite, $3CaO.Al_2O_3.2(SiO_2.CO_2).2H_2O$.
Thaumasite, $CaSiO_3.CaCO_3.CaSO_4.15H_2O$.
Pilolite, Hydrous Ca.Al.Silicate.
Titanite, $CaTiSiO_5$.
Apatite $(CaF)Ca_4(PO_4)_3$.
Wilkeite, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4SO_4)CaO$.
Anapaite, $(Ca,Fe)_3PO_4.4H_2O$.
Autunite, $CaO.2UO_3P_2O_5.8H_2O$.
Volborthite, $(Cu,Ca,Ba)_3(OH)_3VO_4.6H_2O$.
Nitrocalcite, $(Ca,NO_3)_2.nH_2O$.
Colemanite, $Ca_2B_6O_{11}.5H_2O$.
Priceite, $5CaO.6B_2O_3.9H_2O$.
Meyerhofferite, $2CaO.3B_2O_3.7H_2O$.
Inyoite, $2CaO.3B_2O_3.13H_2O$.
Ulexite, $NaCaB_5O_9.8H_2O$.
Hydroboracite, $CaMgB_6O_{11}.6H_2O$.
Bakerite, $8CaO.5B_2O_3.6SiO_2.6H_2O$.
Howlite, $H_5Ca_2B_5SiO_{14}$.
Pyrochlore, Ti,Ca,Ce,Th, niobate.
Microlite, $Ca_2Ta_2O_7$.
Scheelite, $CaWO_4$.
Cuproscheelite, $(Cu,Ca)WO_4$.
Powellite, $CaMoO_4$.
Glauberite, $Na_2SO_4.CaSO_4$.
Anhydrite, $CaSO_4$.
Gypsum, $CaSO_4.2H_2O$.

CARBON.

Diamond, C.
Graphite, C.
Calcite, $CaCO_3$.
Dolomite, $(CaMg)CO_3$.
Ankerite, $CaCO_3.MgCO_3.FeCO_3$.
Magnesite, $MgCO_3$.
Siderite, $FeCO_3$.
Rhodochrosite, $MnCO_3$.
Smithsonite, $ZnCO_3$.
Aragonite, $CaCO_3$.
Strontianite, $SrCO_3$.
Witherite, $BaCO_3$.
Cerussite, $PbCO_3$.
Bismutosphaerite, Bi_2CO_5.
Phosgenite, $(Pb,Cl)_2CO_3$.
Northupite, $Na_2CO_3.MgCO_3.NaCl$.
Tychite, $2MgCO_3.2Na_2CO_3.Na_2SO_4$.
Malachite, $CuCO_3.Cu(OH)_2$.
Azurite, $2CuCO_3.Cu(OH)_2$.
Aurichalcite, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.
Hydrozincite, $ZnCO_3.Zn(OH)_2$.
Dawsonite, $Na_3Al(CO_3)_3.2Al(OH)_3$.
Thermonatrite, $Na_2CO_3.H_2O$.
Gay Lussite, $CaCO_3.Na_2CO_3.5H_2O$.
Natron, $Na_2CO_3.10H_2O$.
Trona, $Na_2CO_3.HNaCO_3.2H_2O$.
Pirssonite, $CaCO_3.Na_2CO_3.2H_2O$.
Hydromagnesite, $3MgCO_3.Mg(OH)_2.3H_2O$.
Hydrogiobertite, $2MgO.CO_2.3H_2O$.
Zaratite, $NiCO_3.2Ni(OH)_2.4H_2O$.
Bismutite, $Bi_2CO_5.H_2O$.
Spurrite, $2CaSiO_4.CaCO_3$.
Plazolite, $3CaO.Al_2O_3.2(SiO_2.CO_3).2H_2O$.
Thaumasite, $CaSiO_3.CaCO_3.CaSO_4.15H_2O$.
Wilkeite, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4SO_4)CaO$.
Hanksite, $4Na_2SO_4.Na_2CO_3$.
Leadhillite, $4PbO.SO_3.2CO_3.H_2O$.
Hydrocarbons.

CERIUM.

Allanite, Fe,Ca,Ce,Al, Silicate.
Uraninite, Pb, U, uranate.
Monazite $(Ce,La,Di)PO_4$.
Pyrochlore, Ti,Ca,Ce,Th, niobate.

CHLORINE.

Calomel, Hg_2Cl_2.
Halite, $NaCl$.
Sylvite, KCl.
Sal Ammoniac, NH_4Cl.
Cerargyrite, $AgCl$.
Chlormagnesite, $MgCl_2$.
Atacamite, $Cu_3ClH_3O_3$.
Eglestonite, Hg_4Cl_2O.
Embolite, $Ag(Br,Cl)$.
Phosgenite, $(PbCl)_2CO_3$.
Northupite, $Na_2CO_3.MgCO_3.NaCl$.
Sodalite, $3NaAlSiO_4.NaCl$.
Wernerite, $Ca_4Al_6Si_6O_{25}+Na_4Al_3Si_9O_{24}Cl$.
Apatite $(CaCl)Ca_4(PO_4)_3$.
Pyromorphite, $(PbCl)Pb_4(PO_4)_3$.
Vanadinite, $(PbCl)Pb_4(VO_4)_3$.
Mimetite, $(PbCl)Pb_4(AsO_4)_3$.
Sulfohalite, $3Na_2SO_4.2NaCl$.

CHROMIUM.

Chromite, $FeCr_2O_4$.
Uvarovite garnet.
Crocoite, $PbCrO_4$.
Knoxvillite, Fe,Cr, Sulphate.
Redingtonite, Fe.Cr, Sulphate.

COBALT.

Cobaltite, CoAsS.
Smaltite, $CoAs_2$.
Danaite (Fe,Co)AsS.
Asbolite, MnO_2,Co,H_2O.
Erythrite, $Co_3As_2O_8.8H_2O$.
Bieberite, $CoSO_4.7H_2O$.

COPPER.

Native Copper, Cu.
Chalcocite, Cu_2S.
Stromeyerite $(Cu,Ag)_2S$.
Covellite, CuS.
Bornite, Cu_3FeS_3.
Cubanite, $CuFe_2S_4$.
Chalcopyrite, $CuFeS_2$.
Bournonite $(Pb,Cu_2)Sb_2S_6$.
Tetrahedrite, $Cu_8Sb_2S_7$.
Enargite, Cu_3AsS_4.
Atacamite, $Cu_2ClH_3O_3$.
Partzite, Sb,Cu,H_2O.
Cuprite, Cu_2O.
Melaconite, CuO.
Crednerite, $Cu_3Mn_4O_9$.
Malachite, $CuCO_3.Cu(OH)_2$.
Azurite, $2CuCO_3.Cu(OH)_2$.
Aurichalcite, $2(Zn,Cu)CO_3.3(Zu,Cu)(OH)_2$.
Chrysocolla, $CuSiO_3.2H_2O$.
Torbernite, $CuO.2UO_3.P_2O_5.8H_2O$.
Cuprodescloizite, $(Pb,Zn,Cu)_2V_2O_8$. $(Pb,Zn,Cu)(OH)_2$.
Volborthite, $(Cu,Ca,Ba)_3(OH)_3VO_4$. $6H_2O$.
Liroconite, Al.Cu, Arsenate.
Cuproscheelite $(Ca,Cu)WO_4$.
Caledonite $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.
Brochantite, $CuSO_4.3Cu(OH)_2$.
Linarite $(Pb,Cu)SO_4.(PbCu)(OH)_2$.
Pisanite, $(Fe,Cu)SO_4.7H_2O$.
Boothite, $CuSO_4.7H_2O$.
Chalcanthite, $CuSO_4.5H_2O$.

FLUORINE.

Fluorite, CaF_2.
Topaz, $Al(O.F_2)AlSiO_4$.
Chondrodite, $[Mg(F,OH)]_2Mg_2(SiO_4$.
Lepidolite, $(K,Li)Al(OH.F)Al(SiO_3)_3$.
Apatite, $(CaF)Ca_4(PO_4)_3$.
Amblygonite, $Li(AlF)PO_4$.

GOLD.

Native gold, Au.
Petzite $(Ag,Au)_2Te$.
Sylvanite, $(Au.Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.
Nagyagite, $Au_2Pb_{14}.Sb_3Te_7S_{17}$.

IRON.

Meteoric iron, Fe.
Awaruite, Ni_3Fe.
Troilite, FeS.
Pyrrhotite, $Fe_{11}S_{12}$.
Bornite, Cu_3FeS_3.
Cubanite, $CuFe_2S_4$.
Chalcopyrite, $CuFeS_2$.
Marcasite, FeS_2.
Pyrite, FeS_2.
Arsenopyrite, FeAsS.
Löllingite, $FeAs_2$.
Berthierite, $FeSb_2S_4$.
Hematite, Fe_2O_3.
Ilmenite $(Fe,Ti)_2O_3$.
Magnetite, Fe_3O_4.
Chromite, $FeCr_2O_4$.
Turgite, $2Fe_2O_3.1H_2O$.
Göthite, $Fe_2O_3.H_2O$.
Limonite, $2Fe_2O_3.3H_2O$.
Ankerite, $CaCO_3.MgCO_3.FeCO_3$.
Siderite, $FeCO_3$.
Hypersthene, $(Fe.Mg)SiO_3$.
Augite, $Ca(Mg,Pe)(SiO_3)_2 + (Mg,Fe)(Al,Fe)_2SiO_6$.
Acmite, $NaFe(SiO_3)_2$.
Anthophyllite, $(Mg,Fe)SiO_3$.

IRON—Continued.

Hornblende, $Ca(Mg,Fe)_3(Al,Fe)_2SiO_3$.
Glaucophane, $NaAl(SiO_3)_2.(Fe,Mg)SiO_3$.
Crocidolite, $NaFe(SiO_3)_2FeSiO_3$.
Almandite, $Fe_3Al_2Si_3O_{12}$.
Andradite, $Ca_3Fe_2Si_3O_{12}$.
Olivine, $(Mg,Fe)_2SiO_4$.
Iddingsite, Fe,Mg,Ca,Na, Silicate.
Epidote, $HCa_2(Al,Fe)_3Si_3O_{13}$.
Allanite, $(Ce,Di,La)Ca,Fe,AlSiO_2$.
Piedmontite, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Hvaite, $CaFe_2(FeOH)(SiO_4)_2$.
Biotite, $(H,K)_2(Mg,Fe)_4(Al,Fe)_2Si_4O_{16}$.
Chloritoid, $H_2(Fe,Mg)Al_2SiO_7$.
Ottrelite, $H_2(Fe,Mn)Al_2Si_2O_9$.
Penninite, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.
Prochlorite, Mg,Fe,Al,Si,H_2O.
Griffithite, $H_4(Mg,Fe,Ca)_4(AlFe)_2Si_5O_{19}.5H_2O$.
Chalcodite, $2(Fe,Mg)O.(Fe,Al)_2O_3.5SiO_2.3H_2O$.
Jefferisite, $2(Mg,Fe)O.(Al,Fe)_2O_3.5SiO_2.5H_2O$.
Celadonite, Fe,Mn,K,SiO_2,H_2O.
Chloropal, $H_6Fe_2Si_3O_{12}.2H_2O$.
Neotocite, Hydrous Mn,Fe, silicate.
Neptunite, Fe,Mn,Na,K titano-silicate.
Triphylite, $LiFePO_4$.
Triplite, $3(Mn,Fe)O.P_2O_5.MnF_2$.
Lazulite, $(Fe,Mg)Al_2(OH)_2P_2O_8$.
Vivianite, $Fe_3P_2O_8.8H_2O$.
Purpurite, $(Fe,Mn)_2O_3.P_2O_5.H_2O$.
Anapaite, $(Ca,Fe)_3PO_4.4H_2O$.
Salmonsite, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.
Strengite, $Fe_2O_3.P_2O_5.4H_2O$.
Sicklerite, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.
Scorodite, $FeAsO_4.2H_2O$.
Pitticite, $Fe_2O_3.As_2O_5,SO_3,H_2O$.
Ludwigite, $3MgO.B_2O_3.FeO.Fe_2O_3$.
Vonsenite, $2(Fe_3Mg)O.B_2O_3.FeO.Fe_2O_3$.
Columbite, $(Fe,Mn)Nb_2O_6$.
Wolframite, $(Mn,Fe)WO_4$.
Melanterite, $FeSO_4.7H_2O$.
Pisanite $(Fe,Cu)SO_4.7H_2O$.
Halotrichite, $FeSO_4.Al_2(SO_4)_3.24H_2O$.
Coquimbite, $Fe_2(SO_4)_3.9H_2O$.
Römerite, $Fe_2(SO_4)_3.12H_2O$.
Copiapite, $2Fe_2O_3.5SO_3.18H_2O$.
Knoxvillite, Fe_2O_3,Cr_2O_3,SO_4.
Redingtonite, $Fe_2O_3,Cr_2O_3.SO_4$.
Fibroferrite, $Fe_2O_3.2SO_3.10H_2O$.
Botryogen, $Fe_2O_3.2MgO.4SO_3.15H_2O$.
Jarosite, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.
Durdenite, $Fe(TeO_3)_3.4H_2O$.

LEAD.

Native lead, Pb.
Galenite, PbS.
Altaite, PbTe.
Nagyagite, $Au_2.Pb_{14}Sb_3Te_7S_{17}$.
Jamesonite, $Pb_2Sb_2S_5$.
Dufrenoysite, $Pb_2As_2S_5$.
Bournonite $(Pb,Cu_2)Sb_2S_6$.
Geocronite, $Pb_5Sb_2S_8$.
Massicot, PbO.
Litharge, PbO.
Minium, Pb_3O_4.
Cerussite, $PbCO_3$.
Phosgenite $(PbCl)_2CO_3$.
Pyromorphite $(PbCl)Pb_4(PO_4)_3$.
Plumbogummite, $PbO.2Al_2O_3.P_2O_5.H_2O$.
Crocoite, $PbCrO_4$.
Vanadinite $(PbCl)Pb_4(VO_4)_3$.
Descloizite, $(Pb,Zn)_2V_2O_8.(Pb,Zn)(OH)_2$.
Mimetite $(PbCl)Pb_4(AsO_4)_3$.
Bindheimite, $Pb_3Sb_2O_8.4H_2O$.
Wulfenite, $PbMoO_4$.
Uraninite, lead uranate.
Uraconite, lead uranate$+H_2O$.
Anglesite, $PbSO_4$.
Leadhillite, $4PbO.SO_3.2CO_2.H_2O$.
Caledonite $(PbCu)SO_4.(PbCu)(OH)_2$.
Linarite $(Pb,Cu)SO_4.(PbCu)(OH)_2$.

LITHIUM.

Tourmaline, Lithia-boro-alumina silicate.
Lepidolite, $(LiK)Al(OH,F)Al(SiO_3)_3$.
Spodumene, $LiAl(SiO_3)_2$.
Triphylite, $LiFePO_4$.
Lithiophilite, $LiMnPO_4$.
Amblygonite, $Li(AlF)PO_4$.
Sicklerite, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.

MAGNESIUM.

Chlormagnesite, $MgCl_2$.
Periclase, MgO.
Spinel, $MgO.Al_2O_3$.
Brucite, $MgO.H_2O$.
Dolomite, $(Ca,Mg)CO_3$.
Ankerite, $(Ca,Mg,Fe)CO_3$.
Magnesite, $MgCO_3$.
Northupite, $Na_2CO_3.MgCO_3.NaCl$.
Tychite, $2MgCO_3.2Na_2CO_3.Na_2SO_4$.
Hydromagnesite, $3MgCO_3Mg(OH)_2.3H_2O$.
Hydrogiobertite, $2MgO.CO_2.3H_2O$.
Enstatite, $MgSiO_3$.
Hypersthene, $(Fe,Mg)SiO_3$.
Pyroxene, $Ca(Mg,Fe)(SiO_3)_2$.
Anthophyllite, $(Mg,Fe)SiO_3$.
Amphibole, $Ca(Mg,Fe)_3(SiO_3)_4$.
Glaucophane, $NaAl(SiO_3)_2.(Fe,Mg)SiO_3$.
Pyrope, $Mg_3Al_2(SiO_4)_3$.
Monticellite, $CaMgSiO_4$.
Olivine, $(Mg,Fe)_2SiO_4$.
Iddingsite, Fe,Mg,Ca,Na,Silicate.
Merwinite, $Ca_3Mg(SiO_4)_2$.
Chondrodite $[Mg(F,OH)]_2Mg_2(SiO_4)_2$.
Phlogopite, $H_2KMg_3Al(SiO_4)_3$.
Biotite, $(H,K)_2(Mg,Fe)_4(Al,Fe)_2(SiO_4)_3$.
Roscoelite, $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$.
Xanthophyllite, $H_8(Mg,Ca)_{14}Al_{16}Si_5O_{52}$.
Chloritoid, $H_2(Fe,Mg)Al_2SiO_7$.
Clinochlore, $H_8Mg_5Al_2Si_3O_{18}$.
Penninite, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.
Prochlorite, $H_{10}(Fe,Mg)_{23}Al_{14}Si_{13}O_{80}$.
Corundophyllite, $H_{20}(Mg,Fe)_{11}Al_8Si_6O_{45}$.
Griffithite, $H_4(Mg,Fe,Ca)_4(Al,Fe)_2Si_5O_{19}.5H_2O$.
Chalcodite, $2(Fe,Mg)O.(Fe,Al)_2O_3.5SiO_2.3H_2O$.
Jefferisite, $2(Mg,Fe)O.(Al,Fe)_2O_3.5SiO_2.5H_2O$.
Jurupaite, $H_2(Ca,Mg)_2Si_2O_7$.
Serpentine, $H_4Mg_3Si_2O_9$.
Deweylite, $4MgO.3SiO_2.6H_2O$.
Garnierite, $H_2(Ni,Mg)SiO_4.nH_2O$.
Talc, $H_2Mg_3Si_4O_{12}$.
Sepiolite, $H_4Mg_2Si_3O_{10}$.
Celadonite, Fe,Mg,K, silicate.
Lazulite, $(Fe,Mg)Al_2(OH)_2P_2O_8$.
Ludwigite, $3MgO.B_2O_3.FeO.Fe_2O_3$.
Vonsenite, $2(Fe,Mg)O.B_2O_3FeO.Fe_2O_3$.
Hydroboracite, $CaMgB_6O_{11}.6H_2O$.
Epsomite, $MgSO_4.7H_2O$.
Blödite, $MgSO_4.Na_2SO_4.4H_2O$.
Boussingaultite, $(NH_4)_2SO_4.MgSO_4.6H_2O$.
Pickeringite, $MgSO_4.Al_2(SO_4)_3.22H_2O$.
Sonomaite, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.
Botryogen, $Fe_2O_3.2MgO.4SO_3.15H_2O$.

MANGANESE.

Alabandite, MnS.
Hausmannite, Mn_3O_4.
Crednerite, $Cu_3Mn_4O_9$.
Braunite, $3Mn_2O_3MnSiO_3$.
Pyrolusite, MnO_2.
Manganite, $Mn_2O_3.H_2O$.
Pyrochroite, $Mn(OH)_2$.
Psilomelane, $MnO_2.Mn_2O_3.H_2O$.
Rhodochrosite, $MnCO_3$.
Rhodonite, $MnSiO_4$.
Spessartite, $Mn_3Al_2Si_3O_{12}$.
Tephroite, Mn_2SiO_4.
Piedmontite, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Ottrelite, $H_2(Fe,Mn)Al_2Si_2O_9$.
Inesite, $2(Mn,Ca)SiO_3.H_2O$.
Ganophyllite, $7MnO.Al_2O_3.8SiO_2.6H_2O$.
Bementite, $2MnSiO_3.H_2O$.
Neotocite, Hydrous Mn,Fe, silicate.
Neptunite, Fe,Mn,Na, titano-silicate.
Triphylite, $Li(Fe,Mn)PO_4$.
Lithiophilite, $LiMnPO_4$.
Triplite, $3(Mn,Fe)O.P_2O_5.MnF_2$.
Purpurite $(Fe,Mn)_2O_3.P_2O_5.H_2O$.
Hureaulite, $5MnO.2P_2O_5.5H_2O$.
Palaite, $5MnO.2P_2O_5.4H_2O$.
Stewartite, Hydrous Mn phosphate.
Salmonsite, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.
Sicklerite, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.
Columbite, $(Fe,Mn)Nb_2O_6$.
Hübnerite, $MnWO_4$.
Wolframite, $(Mn,Fe)WO_4$.

MERCURY.

Native Mercury, Hg.
Metacinnabarite, HgS.
Cinnabar, HgS.
Tiemannite, HgSe.
Coloradoite, HgTe.
Calomel, Hg_2Cl_2.
Eglestonite, Hg_4Cl_2O.

MOLYBDENUM.

Molybdenite, MoS_2.
Molybdite, MoO_3.
Wulfenite, $PbMoO_4$.
Powellite, $CaMoO_4$.

NICKEL.

Awaruite, Ni_3Fe.
Millerite, NiS.
Polydymite, Ni_4S_5.
Niccolite, $NiAs$.
Melonite, Ni_2Te_3.
Zaratite, $NiCO_3.2Ni(OH)_2.4H_2O$.
Garnierite, $H_2(Ni,Mg)SiO_3.nH_2O$.
Annabergite, $Ni_3As_2O_8.8H_2O$.
Morenosite, $NiSO_4.7H_2O$.

NIOBIUM—TANTALIUM.

Pyrochlore, Ti,Ca,Ce,Th, niobate.
Microlite, $Ca_2Ta_2O_7$.
Columbite $(Fe,Mn)Nb_2O_6$.
Stibiotantalite, $m(SbO)_2.Nb_2O_6$ with $n(SbO)_2Ta_2O_6$.

NITROGEN.

Sal Ammoniac, NH_4Cl.
Soda niter, $NaNO_3$.
Niter, KNO_3.
Nitrocalcite, $Ca(NO_3)_2.nH_2O$.
Darapskite, $NaNO_3.Na_2SO_4.H_2O$.
Nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$.
Mascagnite, $(NH_4)_2SO_4$.
Boussingaultite $(NH_4)_2SO_4MgSO_4.6H_2O$.
Tschermigite, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.

PHOSPHOROUS.

Monazite, $(Ce,Di,La)PO_4$.
Triphylite, $Li(Fe,Mn)PO_4$.
Lithiophilite, $LiMnPO_4$.
Triplite, $3(Mn,Fe)O.P_2O_5.MnF_2$.
Apatite, $(CaF)Ca_4(PO_4)_3$.
Pyromorphite, $(PbCl)Pb_4(PO_4)_3$.
Amblygonite, $Li(AlF)PO_4$.
Lazulite, $(Fe,Mg)Al_2(OH)_2P_2O_8$.
Wilkeite, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4,SO_4).CaO$.
Vivianite, $Fe_3P_2O_8.8H_2O$.
Purpurite, $(Fe,Mn)_2O_3.P_2O_5.H_2O$.
Turquois, $AlPO_4.Al(OH)_3.H_2O$.
Variscite, $AlPO_4.2H_2O$.
Plumbogummite, $PbO.2Al_2O_3.P_2O_5.H_2O$.
Anapaite, $(Ca,Fe)_3PO_4.4H_2O$.
Torbernite, $CuO.2UO_3P_2O_5.8H_2O$.
Autunite, $CaO.2UO_3.P_2O_5.8H_2O$.
Hureaulite, $5MnO.2P_2O_5.5H_2O$.
Palaite, $5MnO.2P_2O_5.4H_2O$.
Stewartite, Hydrous Mn-phosphate.
Salmonsite, $Fe_2O_3.9MnO.4P_2O_5.14H_2O$.
Strengite, $Fe_2O_3.P_2O_5.4H_2O$.
Sicklerite, $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$.

PLATINUM GROUP.

Platinum, Pt.
Platiniridium, PtIr.
Iridium, Ir.
Osmium, Os.
Iridosmine, IrOs.
Palladium, Pd.
Rhodium, Ro.
Ruthenium, Ru.

POTASSIUM.

Sylvite, KCl.
Orthoclase, $KAlSi_3O_8$.
Microcline, $KAlSi_3O_8$.
Anorthoclase, $(K,Na)AlSi_3O_8$.
Muscovite, $(H,K)AlSiO_4$.
Mariposite, $(H,K)(Al,Cr)SiO$.
Lepidolite, $(K,Li)Al(OH,F)Al(SiO_3)_3$.
Phlogopite, $H_2KMg_3Al(SiO_4)_3$.
Biotite, $(H,K)_2(Mg,Fe)_4(Al,Fe)_2Si_4O_{16}$.
Roscoelite, $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_2$.
Phillipsite, $(K_2,Ca)Al_2Si_4O_{12}.4H_2O$.
Apophyllite, $H_7KCa_4(SiO_3)_8.4\frac{1}{2}H_2O$.
Niter, KNO_3.
Aphthitalite, $(K,Na)_2SO_4$.
Arcanite, K_2SO_4.
Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.
Alunite, $K_2O.3Al_2O_3.4SO_3.6H_2O$.
Jarosite, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

SELENIUM.

Tiemannite, HgSe.

SILICON.

Quartz, SiO_2.
Chalcedony, SiO_2.
Tridymite, SiO_2.
Cristobalite, SiO_2.
Opal, $SiO_2.nH_2O$.
Orthoclase, $KAlSi_3O_8$.
Microcline, $KAlSi_3O_8$.
Anorthoclase, $(K,Na)AlSi_3O_8$.
Albite, $NaAlSi_3O_8$.
Oligoclase, Andesine, Labradorite, Bytownite, $mNaAlSi_3O_8 + nCaAl_2Si_2O_8$.
Anorthite, $CaAl_2Si_2O_8$.
Enstatite, $MgSiO_3$.
Hypersthene, $(Fe,Mg)SiO_3$.
Pyroxene, $Ca(Mg,Fe)Si_2O_6 + (Al,Fe)SiO_6$.
Acmite, $NaFe(SiO_3)_2$.
Spodumene, $LiAl(SiO_3)_2$.
Wollastonite, $CaSiO_3$.
Pectolite, $HNaCa_2(SiO_3)_3$.
Rhodonite, $MnSiO_3$.
Anthophyllite, $(Mg,Fe)SiO_3$.
Amphibole, $Ca(Mg,Fe)_3(SiO_3)_4 + (Al,Fe)_2SiO_6$.
Glaucophane, $NaAl(SiO_3)_2.(Fe,Mg)SiO_3$.
Crocidolite, $NaFe(SiO_3)_2FeSiO_3$.
Beryl, $Be_3Al_2Si_6O_{18}$.
Nepheline, $K_2Na_6Al_8Si_9O_{35}$.
Sodalite, $3NaAlSiO_4.NaCl$.
Noselite, $Na_4(NaSO_4.Al)Al_2(SiO_4)_3$.
Lazurite, $Na_4(NaS.Al)Al_2(SiO_4)_3$.
Garnet, $Ca_3Al_2(SiO_4)_3$ etc.
Monticellite, $CaMgSiO_4$.
Olivine, $(Mg,Fe)_2SiO_4$.
Tephroite, Mn_2SiO_4.
Iddingsite, Fe,Mg,Ca,Na,SiO_2.
Willemite, Zn_2SiO_4.
Wernerite, $mCa_4Al_6Si_6O_{25} + nNa_4Al_3Si_9O_{24}Cl$.
Gehlenite, $Ca_2Al_2Si_2O_9$.
Merwinite, $Ca,Mg(SiO_4)_2$.
Vesuvianite, $H_8Ca_{12}(Al,Fe)_6Si_{10}O_{43}$.
Zircon, $ZrSiO_4$.
Topaz, $Al(O,F_2)AlSiO_4$.
Andalusite, Al_2SiO_5.
Sillimanite, Al_2SiO_5.
Cyanite, Al_2SiO_5.
Spurrite, $2CaSiO_4.CaCO_3$.
Datolite, $HCaBSiO_5$.
Zoisite, $HCa_2Al_3Si_3O_{13}$.
Epidote, $HCa_2(Al,Fe)_3Si_3O_{13}$.
Allanite, (Ce,Di,La)Ca,Al,Fe, silicate.
Piedmontite, $HCa_2(Al,Mn,Fe)_3Si_3O_{13}$.
Axinite, $H(Ca,Mn,Fe)_3BAl_2(SiO_4)_4$.
Prehnite, $H_2Ca_2Al_2(SiO_4)_3$.
Chondrodite, $[Mg(F,OH)]_2Mg_2(SiO_4)_2$.
Hvaite, $CaFe_2(FeOH)(SiO_4)_2$.
Calamine, $H_2Zn_2SiO_5$.
Lawsonite $H_4CaAl_2Si_2O_{10}$.
Tourmaline, (Na,Li,K),(Mg,Fe,Ca),(B,Al,Fe),SiO_2.
Dumortierite, $HAl_8BSi_3O_{20}$.
Muscovite, $H_2KAl_3(SiO_4)_3$.
Mariposite, $H_2K(Al,Cr)_3(SiO_4)_3$.
Paragonite, $H_2NaAl_3Si_3O_{12}$.
Lepidolite, $K,Li[Al(OH,F)_2]Al(SiO_3)_3$.
Phlogopite, $H_2KMg_3Al(SiO_4)_3$.
Biotite, $(H,K)_2(Mg,Fe)_2(Al,Fe)_2(SiO_4)_3$.
Roscoelite, $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$.
Margarite, $H_2CaAl_4Si_2O_{12}$.

SILICON—Continued.

Xanthophyllite, $H_8(Mg,Ca)_{11}Al_{10}Si_5O_{32}$.
Chloritoid, $H_2(Fe,Mg)Al_2SiO_7$.
Ottrelite, $H_2(Fe,Mn)Al_2Si_2O_9$.
Clinocholre, $H_8Mg_5Al_2Si_3O_{18}$.
Penninite, $H_8(Mg,Fe)_5Al_2Si_3O_{18}$.
Prochlorite, $H_{40}(Fe,Mg)_{23}Al_{14}Si_{13}O_{90}$.
Corundophyllite, $H_{20}(Fe,Mg)_{11}Al_8Si_6O_{45}$.
Grilfithite, $H_4(Mg,Fe,Ca)_4(Al,Fe)_2Si_5O_{19}.5H_2O$.
Chalcodite, $2(Fe,Mg)O.(Fe,Al)_2O_3.5SiO_2.3H_2O$.
Jefferisite, $2(Fe,Mg)O.(Fe,Al)_2O_3.5SiO_2.5H_2O$.
Heulandite, $H_4CaAl_2(SiO_3)_6.3H_2O$.
Phillipsite, $(K_2,Ca)Al_2Si_4O_{12}.4\frac{1}{2}H_2O$.
Laumontite, $H_4CaAl_2Si_4O_{14}.2H_2O$.
Stilbite, $(Na_2,Ca)Al_2Si_6O_{16}6H_2O$.
Chabazite, $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.
Analcite, $NaAl(SiO_3)_2.H_2O$.
Natrolite, $Na_2Al_2Si_3O_{10}.2H_2O$.
Mesolite, $(Na_2,Ca)Al_2Si_3O_{10}.3H_2O$.
Thomsonite, $(Na_2,Ca)Al_2(SiO_4)_2.2\frac{1}{2}H_2O$.
Gyrolite, $H_2Ca_2Si_3O_9.H_2O$.
Jurupaite, $H_2(Ca,Mg)_2Si_2O_7$.
Apophyllite, $H_7KCa_4(SiO_3)_8.4\frac{1}{2}H_2O$.
Eakleite, $H_2Ca_5Si_3O_{16}$.
Okenite, $H_2CaSi_2O_6.H_2O$.
Inesite, $2(Mn,Ca)SiO_3.H_2O$.
Ganophyllite, $7MnO.Al_2O_3.8SiO_2.6H_2O$.
Crestmoreite, H_2CaSiO_4.
Riversideite, $Ca_2Si_2O_6.H_2O$.
Plazolite, $3CaO.Al_2O_3.2(SiO_2,CO_2).2H_2O$.
Serpentine, $H_4Mg_3Si_2O_9$.
Deweylite, $4MgO.3SiO_2.6H_2O$.
Garnierite, $H_2(Ni,Mg)SiO_4.nH_2O$.
Tale, $H_2Mg_3Si_4O_{12}$.
Sepiolite, $H_4Mg_2Si_3O_{10}$.
Celadonite, Fe,Mg,K, silicate $+H_2O$.
Pyrophyllite, $H_2Al_2Si_4O_{12}$.
Allophane, $Al_2SiO_5.5H_2O$.
Kaolinite, $Al_2O_3.2SiO_2.H_2O$.
Halloysite, $H_4Al_2Si_2O_9.H_2O$.
Montmorillonite, $H_2Al_2Si_4O_{12}.nH_2O$.
Rectorite, $Al_2O_3.2SiO_2.H_2O$.
Cimolite, $2Al_2O_3.9SiO_2.6H_2O$.
Thaumasite, $CaSiO_3.CaCO_3.CaSO_4.15H_2O$.
Chrysocolla, $CuSiO_3.2H_2O$.
Chloropal, $H_8Fe_2Si_3O_{12}.2H_2O$.
Bementite, $2MnSiO_3.H_2O$.
Neotocite, Hydrous Mn,Fe, silicate.
Pilolite, Hydrous Ca,Al,Silicate.
Searlesite, $NaB(SiO_3)_2.H_2O$.
Titanite, $CaTiSiO_5$.
Benitoite, $Ba.TiSi_3O_9$.
Neptunite, Fe,Mn,K,Na, titano-silicate.
Wilkeite, $3Ca_3(PO_4)_2.CaCO_3+3Ca_3(SiO_4.SO_4)_2.CaO$.
Bakerite, $8CaO.5B_2O_3.6SiO_2.6H_2O$.
Howlite, $H_5Ca_2B_5SiO_4$.

SILVER.

Native silver, Ag.
Argentite, Ag_2S.
Stromeyerite $(Ag,Cu)_2S$.
Hessite, Ag_2Te.
Petzite $(Au,Ag)_2Te$.
Sylvanite $(Au,Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.
Nagyagite, $Au_2Pb_{14}Sb_3Te_7S_{17}$.
Miargyrite, $AgSbS_2$.
Pyrargyrite, Ag_3SbS_3.
Proustite, Ag_3AsS_3.
Stephanite, Ag_5SbS_4.
Polybasite, Ag_9SbS_6.
Cerargyrite, AgCl.
Embolite, Ag(Cl,Br).

SODIUM.

Halite, NaCl.
Northupite, $Na_2CO_3MgCO_3.NaCl$.
Tychite, $2Mg.CO_3.2Na_2CO_3.Na_2SO_4$.
Dawsonite, $Na_3Al(CO_3)_3.2Al(OH)_3$.
Thermonatrite, $Na_2CO_3.H_2O$.
Gay-Lussite, $CaCO_3.Na_2CO_3.5H_2O$.
Natron, $Na_2CO_3.10H_2O$.
Trona, $Na_2CO_3.HNaCO_3.2H_2O$.
Pirssonite, $CaCO_3.Na_2CO_3.2H_2O$.
Anorthoclase, $(K,Na)AlSi_3O_8$.
Albite, $NaAlSi_3O_8$.
Oligoclase, Andesine, Labradorite, Bytownite, $nNaAlSi_3O_8+mCaAl_2Si_2O_8$.
Acmite, $NaFe(SiO_3)_2$.
Pectolite, $HNaCa_2(SiO_3)_2$.
Glaucophane, $NaAl(SiO_3)_2.(Fe,Mg)SiO_3$.
Crocidolite, $NaFe(SiO_3)_2FeSiO_3$.
Nepheline, $K_2Na_6Al_8Si_9O_{34}$.

SODIUM—Continued.

Sodalite, $3NaAlSiO_4.NaCl$.
Noselite, $Na_4(NaSO_4.Al)Al_2(SiO_4)_3$.
Lazurite, $Na_4(NaS_3.Al)(SiO_4)_3$.
Wernerite, $m(Ca_4Al_6Si_6O_{25}+nNa_4Al_3Si_9O_{24}Cl)$.
Paragonite, $H_2NaAl_3Si_3O_{12}$.
Stilbite, $H_4(Na_2Ca)Al_2Si_6O_{18}.4H_2O$.
Chabazite, $(Ca,Na_2)Al_2Si_4O_{12}.6H_2O$.
Analcite, $NaAlSi_2O_6.H_2O$.
Natrolite, $Na_2Al_2Si_3O_{10}.2H_2O$.
Mesolite, $(Ca,Na_2)Al_2Si_3O_{10}.2H_2O$.
Thomsonite, $(Na_2Ca)Al_2Si_2O_8.2\frac{1}{2}H_2O$.
Scarlesite, $NaB(SiO_3)_2.H_2O$.
Soda niter, $NaNO_3$.
Darapskite, $NaNO_3.Na_2SO_4.H_2O$.
Nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$.
Borax, $Na_2B_4O_7.10H_2O$.
Ulexite, $NaCaB_5O_9.8H_2O$.
Thenardite, Na_2SO_4.
Aphthitalite, $(K,Na)_2SO_4$.
Glauberite, $Na_2SO_4.CaSO_4$.
Sulfohalite, $3Na_2SO_4.2NaCl$.
Hanksite, $4NaSO_4.Na_2CO_3$.
Mirabilite, $Na_2SO_4.10H_2O$.
Blödite, $MgSO_4.Na_2SO_4.4H_2O$.
Mendozite, $Na_2SO_4.Al_2(SO_4)_3.24H_2O$.

STRONTIUM.

Strontianite, $SrCO_3$.
Celestite, $SrSO_4$.

SULPHUR.

Native Sulphur, S.
Realgar, AsS.
Orpiment, As_2S_3.
Stibnite, Sb_2S_3.
Bismuthinite, Bi_2S_3.
Molybdenite, MoS_2.
Argentite, Ag_2S.
Galenite, PbS.
Chalcocite, Cu_2S.
Stromeyerite, $(Cu,Ag)_2S$.
Schalerite, ZnS.
Alabandite, MnS.
Metacinnabarite, HgS.
Cinnabar, HgS.
Greenockite, CdS.
Covellite, CuS.
Millerite, NiS.
Troilite, FeS.
Pyrrhotite, Fe_nS_{n+1}.
Polydymite, Ni_4S_5.
Bornite, Cu_3FeS_3.
Cubanite, $CuFe_2S_4$.
Chalcopyrite, $CuFeS_2$.
Marcasite, FeS_2.
Pyrite, FeS_2.
Kermesite, Sb_2S_2O.
Voltzite, Zn_5S_4O.
Cobaltite, CoAsS.
Arsenopyrite, FeAsS.
Nagyagite, $Au_2Pb_{14}Sb_2Te_7S_{17}$.
Berthierite, $FeSb_2S_4$.
Jamesonite, $Pb_2Sb_2S_5$.
Bournonite, $(Pb,Cu_2)_3Sb_2S_6$.
Miargyrite, $AgSbS_2$.
Pyrargyrite, $Ag_3Sb_2S_3$.
Tetrahedrite, $Cu_8Sb_2S_7$.
Geocronite, $Pb_5Sb_2S_8$.
Stephanite, $Ag_5Sb_2S_4$.
Dufrenoysite, $Pb_2As_2S_5$.
Proustite, Ag_3AsS_3.
Enargite, Cu_3AsS_4.
Tychite, $2MgCO_3.2Na_2CO_3.Na_2SO_4$.
Noselite, $Na_4(NaSO_4.Al)Al_2(SiO_4)_3$.
Lazurite, $Na_4(NaS_3.Al)(SiO_4)_3$.
Thaumasite, $CaSiO_3.CaCO_3.CaSO_4.15H_2O$.
Wilkeite, $3Ca_3(PO_4)_2.CaCO_3+3Ca_4(SiO_4.SO_4).CaO$.
Pitticite, $Fe_2O_3.As_2O_5.SO_3.H_2O$.
Darapskite, $NaNO_3.Na_2SO_4.H_2O$.
Nitroglauberite, $6NaNO_3.2Na_2SO_4.3H_2O$.
Mascagnite, $(NH_4)_2SO_4$.
Thenardite, Na_2SO_4.
Aphthitalite, $(K,Na)_2SO_4$.
Arcanite, K_2SO_4.
Glauberite, $Na_2SO_4.CaSO_4$.
Barite, $BaSO_4$.
Celestite, $SrSO_4$.
Anglesite, $PbSO_4$.
Anhydrite, $CaSO_4$.
Sulfohalite, $3Na_2SO_4.2NaCl$.
Hanksite, $4Na_2SO_4.Na_2CO_3$.
Leadhillite, $4PbO.SO_3.2CO_2.H_2O$.
Caledonite, $(Pb,Ca)SO_4(Pb,Cu)(OH)_2$.
Brochantite, $CuSO_4.3Cu(OH)_2$.
Linarite, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$.
Mirabilite, $Na_2SO_4.10H_2O$.
Gypsum, $CaSO_4.2H_2O$.
Epsomite, $MgSO_4.7H_2O$.

SULPHUR—Continued.

Goslarite, $(ZnSo_4)7H_2O$.
Morenosite, $NiSO_4.7H_2O$.
Melanterite, $FeSO_4.7H_2O$.
Pisanite, $(Fe,Cu)SO_4.7H_2O$.
Bieberite, $CoSO_4.7H_2O$.
Boothite, $CuSO_4.7H_2O$.
Chalcanthite, $CuSO_4.5H_2O$.
Blödite, $MgSO_4.Na_2SO_4.4H_2O$.
Boussingaultite, $(NH_4)_2SO_4.MgSO_4.6H_2O$.
Kalinite, $K_2SO_4.Al_2(SO_4)_3.24H_2O$.
Tschermigite, $(NH_4)_2SO_4.Al_2(SO_4)_3.24H_2O$.
Mendozite, $Na_2SO_4.Al_2(SO_4)_3.24H_2O$.
Pickeringite, $MgSO_4.Al_2(SO_4)_3.22H_2O$.
Halotrichite, $FeSO_4.Al_2(SO_4)_3.24H_2O$.
Sonomaite, $3MgSO_4.Al_2(SO_4)_3.33H_2O$.
Coquimbite, $Fe_2(SO_4)_3.9H_2O$.
Alunogen, $Al_2(SO_4)_3.18H_2O$.
Römerite, $Fe_2(SO_4)_3.12H_2O$.
Copiapite, $2Fe_2O_3.5SO_3.18H_2O$.
Knoxvillite, Hydrous Fe,Al,Cr, sulphate.
Redingtonite, Hydrous Fe,Al,Cr, sulphate.
Fibroferrite, $Fe_2O_3(SO_3)_2.10H_2O$.
Botryogen, $Fe_2O_3.2MgO.4SO_3.15H_2O$.
Alunite, $K_2O.3Al_2O_3.4SO_3.6H_2O$.
Jarosite, $K_2O.3Fe_2O_3.4SO_3.6H_2O$.

TELLURIUM.

Native tellurium, Te.
Tetradymite, Bi_2Te.
Hessite, Ag_2Te.
Petzite $(Ag,Au)_2Te$.
Altaite, PbTe.
Coloradoite, HgTe.
Melonite, Ni_2Te_3.
Sylvanite $(Au,Ag)Te_2$.
Calaverite $(Au,Ag)Te_2$.
Nagyagite, $Au_2Pb_{14}Sb_2Te_7S_{17}$.
Durdenite, $Fe(TeO_3)_3.4H_2O$.

THORIUM.

Monazite, $(Ce,La,Di,Th)PO_4$.
Pyrochlore, Ti,Ca,Ce,Th, niobate.

TIN.

Native tin, Sn.
Cassiterite, SnO_2.

TITANIUM.

Ilmenite, $(Fe,Ti)_2O_3$.
Rutile, TiO_2.
Brookite, TiO_2.
Anatase, TiO_2.
Titanite, $CaTiSiO_5$.
Benitoite, $BaTiSi_3O_9$.
Neptunite, $(Na,K)_2(Fe,Mn)TiSi_4O_{12}$.
Pyrochlore, Ti,Ca,Ce,Th, niobate.

TUNGSTEN.

Hübnerite, $MnWO_4$.
Wolframite, $(Mn,Fe)WO_4$.
Scheelite, $CaWO_4$.
Cuproscheelite, $(Ca,Cu)WO_4$.

URANIUM.

Torbernite, $CuO.2UO_3.P_2O_5.8H_2O$.
Autunite, $CaO.2UO_3.P_2O_5.8H_2O$.
Uraninite, Uranate of lead.
Uraconite, Uranate of lead, H_2O.

VANADIUM.

Roscoelite, $H_8K(Mg,Fe)(Al,V)_4(SiO_3)_{12}$.
Pucherite, $BiVO_4$.
Vanadinite $(PbCl)Pb_4(VO_4)_3$.
Volborthite, Cu,Ba,Ca, vanadate.
Descloizite, Pb,Zn,Cu, vanadate.

ZINC.

Native zinc, Zn.
Sphalerite, ZnS.
Voltzite, Zn_5S_4O.
Smithsonite, $ZnCO_3$.
Aurichalcite, $2(Zn,Cu)CO_3.3(Zn,Cu)(OH)_2$.
Hydrozincite, Basic zinc carbonate.
Willemite, Zn_2SiO_4.
Calamine, $H_2Zn_2SiO_5$.
Descloizite, $(Pb,Zn)_2(VO_4)_2.(Pb,Zn)(OH)_2$.
Goslarite, $ZnSO_4.7H_2O$.

ZIRCONIUM.

Zircon, $ZrSiO_4$.

GEM MINERALS.

Agate.
Amethyst.
Axinite.
Benitoite.
Beryl.
Californite.
Carnelian.
Chalcedony.
Chiastolite.
Chrysoberyl.
Chrysolite.
Chrysopal.
Chrysoprase.
Crocidolite.
Diamond.
Dumortierite.
Emerald.
Garnet.
Hiddenite.
Jasper.
Kinradite.
Kunzite.
Lapis Lazuli.
Moonstone.
Myrickite.
Opal.
Quartz.
Rhodonite.
Ruby.
Sapphire.
Satelite.
Rutile.
Spinel.
Titanite.
Topaz.
Tourmaline.
Turquois.
Vesuvianite.
Zircon.

MINERAL DISTRIBUTION BY COUNTIES.

All of the minerals mentioned in the foregoing pages are listed by counties in order to show their distribution. The particular locality or description of any mineral can easily be seen by reference to the mineral. There are many scattered localities and several which are noted for the great variety of associated minerals. The desert counties lead in number of species because they have minerals not only typical of mountainous regions, such as vein minerals, contact metamorphic minerals and secondary minerals in the oxidation zones of veins, but in addition, minerals typical of the dry plains and former marshes and lakes, such as the borates, sulphates, carbonates, nitrates and chlorides. Inyo and San Bernardino counties therefore lead, and the Cerro Gordo district and Death Valley in the former, and the Searles Lake and Calico district in the latter, are the most famous single localities.

San Diego County ranks as the gem county of the State. The great series of lithia-bearing pegmatites which intersect the diorites at Pala and Mesa Grande contain the beautiful pink tourmaline and pink kunzite with many associated minerals.

The limestone quarries at Crestmore, Riverside County, have yielded many interesting lime minerals as products of contact metamorphism, and several of them are new mineral species.

The minerals occurring in the gold regions of the Sierras are in general the common sulphides and rock-forming minerals. Carson Hill in Calaveras County and the mines near Jamestown and Tuttletown in Tuolumne County were noted for the rarer telluride minerals associated with the gold.

Some of the cinnabar mines have also been noted for rare and interesting mineral associations. Several new species came from the old Redington mine, afterwards named the Boston mine, at Knoxville, Napa County. The Sulphur Bank mine, on Clear Lake, Lake County, and the New Almaden mine, Santa Clara County, have produced several rare minerals.

Other localities are known for their mineral associations, but it is only of those districts which have been studied by men who have known the minerals, that we have fairly complete lists.

Alameda County.—Actinolite, albite, alunogen, analcite, bementite, boothite, calcite, chalcanthite, chalcedony, chalcopyrite, chromite, cinnabar, coal, copiapite, copper, cuprite, dolomite, enstatite, epsomite, halite, halotrichite, hematite, hydromagnesite, inesite, kämmererite, limonite, magnesite, magnetite, manganite, melanterite, natrolite, petroleum, pisanite, psilomelane, pyrite, pyrolusite, pyrophyllite, quartz, rhodochrosite, rhodonite, serpentine, talc, vivianite, wollastonite, zaratite, zircon.

Alpine County.—Argentite, arsenolite, barite, biotite, calcite, chalcocite, chalcopyrite, enargite, epidote, famatinite, galena, garnet, gold, gypsum, hematite, jasper, kalinite, marcasite, polybasite, pyrargyrite, pyrite, realgar, rose quartz, silver, sphalerite, stephanite, stromeyerite, tetrahedrite, tourmaline, wood opal.

Amador County.—Amethyst, arsenopyrite, asbestos, biotite, calcite, chalcanthite, chalcedony, chalcopyrite, chromite, chrysocolla, clay, coal, copper, cuprite, diamond, epsomite, galena, gold, ilmenite, ionite, limonite, löllingite, magnetite, malachite, melanterite, mendozite, psilomelane, pyrite, pyrolusite, rectorite, rhodochrosite, rock crystal, rose quartz, rutile, serpentine, talc, tellurium, tremolite, wood opal.

Butte County.—Asbestos, azurite, barite, californite, chalcopyrite, chromite, chrysoberyl, diamond, epidote, galena, garnet, gold, gypsum, hematite, hornblende, ilmenite, lead, limonite, magnetite, marble, monazite, olivine, platinum minerals, prochlorite, psilomelane, pyrolusite, pyrophyllite, rhodochrosite, rhodonite, rutile, smoky quartz, talc, topaz, vesuvianite, wood opal, zircon.

Calaveras County.—Actinolite, albite, altaite, ankerite, aragonite, arsenopyrite, azurite, barite, boothite, bornite, brochantite, calcite, calaverite, chalcanthite, chalcedony, chalcocite, chalcopyrite, chloritoid, chromite, chrysocolla, chrysotile, cinnabar, clay, copper, coquimbite, covellite, cuprite, dolomite, durdenite, epidote, galena, garnet, gold, graphite, hematite, hessite, hyalite, ilmenite, jamesonite, jasper, kalinite, kotschubeite, limonite, lithomarge, magnesite, magnetite, malachite, manganite, margarite, mariposite, melanconite, melonite, millerite, opal, orthoclase, petzite, platinum minerals, psilomelane, pyrite, pyromorphite, pyrolusite, pyrrhotite, quartz, rectorite, siderite, silver, sphalerite, stibnite, sylvanite, talc, tellurium, tetradymite, tetrahedrite, tourmaline, uraconite, uraninite, valencianite, vivianite, wood opal, zircon.

Colusa County.—Alunite, aragonite, chalcocite, chalcopyrite, chalcotrichite, coal, chromite, cinnabar, copper, cuprite, electrum, epidote, gypsum, halite, hematite, lignite, limonite, manganite, melanconite, metacinnabarite, pyrite, pryolusite, sulphur, quartz.

Contra Costa County.—Actinolite, albite, analcite, anthophyllite, apatite, chalcopyrite, cinnabar, clay, coal, crossite, diopside, enstatite, epidote, fluorite, glaucophane, gypsum, hyalite, lawsonite, manganite, opal, petroleum, prochlorite, psilomelane, pyrolusite, serpentine, talc, titanite, tremolite, zircon.

Del Norte County.—Agate, arsenopyrite, awarnite, bornite, chalcedony, chalcocite, chalcopyrite, chromite, cinnabar, copper, cuprite, diamond, enstatite, garnet, gold, graphite, hematite, ilmenite, jasper, kämmererite, magnetite, malachite, melanconite, molybdite, monazite, olivine, penninite, platinum minerals, pyrrhotite, tetrahedrite, tremolite, troilite, wollastonite, zircon.

El Dorado County.—Actinolite, adularia, agalmatolite, anatase, antimony, arsenopyrite, asbestos, axinite, azurite, barite, beryl, bismuth-gold, bornite, brookite, calaverite, calcite, chalcedony, chalcocite, chalcopyrite, chloropal, chromite, cinnabar, clay, copper, coquimbite, covellite, cubanite, cuprite, diamond, diopside, dolomite, enargite, epidote, galena, garnet, gold, grossularite, hematite, hessite, hornblende, ilmenite, limonite, ludwigite, magnetite, mariposite, meteorite, molybdenite, monazite, nontronite, orthoclase, petzite, platinum, pyrite, pyrolusite, pyromorphite, pyrophyllite, pyrrhotite, quartz, roscoelite, serpentine, siderite, sphalerite, talc, tin, titanite, tourmaline, variscite, vesuvianite, wulfenite, zircon.

Fresno County.—Andalusite, apatite, arsenopyrite, asbestos, barite, beryl, bindheimite, bismuthinite, bismutite, bornite, calcite, californite, chiastolite, chalcopyrite, chromite, chrysocolla, chrysoprase, chrysotile, cinnabar, coal, columbite, copper, cuprite, diamond, diatomaceous earth, enstatite, epidote, galena, garnet, glaucophane, gold, graphite, gypsum, hornblende, ilmenite, kalinite, magnesite, magnetite, molybdenite, moss opal, orthoclase, petroleum, psilomelane, pyrrhotite, rhodonite, rutile, scheelite, sphalerite, stilbite, talc, tantalite, topaz.

Glenn County.—Calcite, chromite, cinnabar, copper, cuprite, halite, psilomelane, quartz, rhodonite, talc, volborthite.

Humboldt County.—Actinolite, agate, albite, apatite, bementite, carnelian, chalcedony, chalcocite, chalcopyrite, chromite, cinnabar, coal, copper, covellite, cuprite, epidote, garnet, glaucophane, gold, graphite, hematite, hornblende, ilmenite, jasper, jet, magnetite, malachite, monazite, neotocite, olivine, petroleum, platinum minerals, prase, psilomelane, pyrolusite, pyrrhotite, rhodonite, rutile, sphalerite, spinel, vivianite, zircon.

Imperial County.—Agate, arsenopyrite, blödite, calcite, cerussite, chalcopyrite, cyanite, diamond, dumortierite, electrum, epsomite, galena, garnierite, graphite, gypsum, halite, ilmenite, magnetite, mirabilite, psilomelane, siderite, sulphur, tetrahedrite, thenardite.

Inyo County.—Analcite, andradite, anglesite, anhydrite, argentite, asbestos, atacamite, aurichalcite, axinite, azurite, barite, bindheimite, bismuthinite, bismutite, boracite, borax, bornite, botryogen, bournonite, brochantite, calamine, calcite, caledonite, celestite, cerargyrite, cerussite, cervantite, chalcocite, chalcodite, chalcopyrite, chrysocolla, cinnabar, colemanite, copper, coquimbite, covellite, crocoite, cuprite, darapskite, datolite, dawsonite, diatomaceous earth, dolomite, dufrenoysite, embolite, epidote, fluorite, galena, garnet, gay-lussite, geocronite, göthite, gold, graphite, gypsum, halite, halloysite, hanksite, hematite, howlite, hydroboracite, hydromagnesite, hydrozincite, inyoite, jamesonite, jasper, kalinite, leadhillite, lenzinite, lepidolite, limonite, linarite, liroconite, magnetite, malachite, malacolite, marble, melaconite, mendozite, metacinnabarite, meyerhofferite, mimetite, molybdenite, montmorillonite, mountain cork, muscovite, natrolite, natron, niter, nitroglauberite, orthoclase, petzite, phlogopite, phosgenite, pickeringite, platinum, plumbogummite, priceite, psilomelane, pyromorphite, pyrophyllite, pyrrhotite, rock crystal, sal ammoniac, scheelite, scorodite, sepiolite, serpentine, siderite, silimanite, silver, smithsonite, soda niter, sphalerite, stibnite, stromeyerite, strontianite, sulphur, sylvite, talc, tetrahedrite, thenardite, thermonatrite, titanite, tourmaline, tremolite, trona, turgite, ulexite, vesuvianite, willemite, wolframite, wulfenite.

Kern County.—Actinolite, albite, anglesite, antimony, argentite, arsenopyrite, asphalt, azurite, barite, borax, cerargyrite, cerussite, cervantite, chalcedony, chalcocite, chalcopyrite, chiastolite, chloropal, chromite, chrysotile, cinnabar, clay, coccinite, colemanite, cuprite, cuproscheelite, enstatite, epidote, galena, garnet, gilsonite, gypsite, halite, halloysite, hematite, hessite, ilmenite, jarosite, kermesite, lead, lepidomelane, magnesite, magnetite, malachite, manganite, marble, mariposite, massicot, meteorite, minium, molybdenite, mountain cork, mountain leather, opal, orthoclase, petroleum, platinum minerals, proustite, pyrargyrite, pyrolusite, quartz, scheelite, sepiolite, silver, smithsonite, sphalerite, stibiconite, stibnite, sulphur, talc, tourmaline, tremolite, ulexite, vanadinite, vesuvianite, wolframite, wulfenite.

Kings County.—Chromite, cinnabar, gypsite, magnesite, malachite, mercury.

Lake County.—Barite, borax, calcite, chalcocite, chalcopyrite, chromite, cimolite, cinnabar, clay, copiapite, copper, crocidolite, epsomite, glaucophane, gypsum, hornblende, kalinite, limonite, malachite, melanterite, mercury, metacinnabarite, neotocite, opal, orpiment, posepnyte, psilomelane, pyrolusite, pyrrhotite, realgar, sassolite, serpentine, stibnite, sulphur, tiemannite, tschermigite, violan, wollastonite, zoisite.

Lassen County.—Annabergite, azurite, bernardinite, bornite, chalcocite, chalcopyrite, copper, cuprite, epidote, garnet, gypsum, halloysite, hematite, jefferisite, malachite, mesolite, muscovite, smaltite, sulphur, tourmaline, wood opal.

Los Angeles County.—Anhydrite, annabergite, argentite, asbolite, asphalt, barite, bismutite, bornite, calcite, chalcedony, chalcocite, chalcopyrite, chromite, chrysocolla, clay, colemanite, copper, corundum, cyanite, diatomaceous earth, diopside, epidote, erythrite, fluorite, galena, garnet, graphite, griffithite, gypsum, howlite, iddingsite, ilmenite, kalinite, labradorite, lapis lazuli, lazulite, leucopyrite, magnesite, magnetite, malachite, olivine, orthoclase, petroleum, pyrolusite, sal ammoniac, siderite, silver, smaltite, sodalite, sphalerite, stibnite, talc, tetrahedrite, tremolite, ulexite, vesuvianite, vivianite.

Madera County.—Actinolite, arsenopyrite, asbestos, azurite, bismuthinite, chalcocite, chalcopyrite, chromite, covellite, electrum, galena, garnet, hematite, ilmenite, lazurite, magnetite, molybdenite, orthoclase, pyrolusite, pyrrhotite, rhodochrosite, rhodonite, sphalerite, talc, tourmaline, vivianite, wolframite, zaratite.

Marin County.—Actinolite, agate, albite, asbestos, chalcedony, chalcopyrite, chromite, cinnabar, epidote, garnet, glaucophane, hematite, hornblende, jasper, kinradite, lawsonite, manganite, margarite, psilomelane, pyrolusite, pyrophyllite, pyrrhotite, quartz, talc, titanite, wolframite, zircon.

Mariposa County.—Alunite, andalusite, ankerite, argentite, arsenopyrite, asbestos, azurite, barite, biotite, bronzite, calcite, chalcocite, chalcopyrite, chloropal, chrysocolla, cinnabar, cobaltite, copper, covellite, danaite, epsomite, erythrite, epidote, galena, garnet, gold, gold amalgam, göthite, gypsum, hornblende, ilmenite, labradorite, limonite, magnetite, malachite, mariposite, melanterite, molybdenite, orthoclase, pitticite, platinum, proustite, psilomelane, pyrargyrite, pyrite, pyrolusite, pyromorphite, pyrrhotite, pyrophyllite, rhodochrosite, rock crystal, scorodite, serpentine, sepiolite, siderite, sillimanite, sphalerite, stibnite, sulphur, talc, tetrahedrite, tourmaline, witherite, wolframite.

Mendocino County.—Barite, bementite, chalcopyrite, chromite, copper, garnet, glaucophane, hematite, inesite, jasper, jefferisite, magnesite, malachite, manganite, neotocite, olivine, platinum minerals, psilomelane, pyrite, pyrolusite, tetrahedrite, uvarovite, zircon.

Merced County.—Barite, calcite, cinnabar, copper, diatomaceous earth, psilomelane, soda niter, stibnite.

Modoc County.—Azurite, calcite, chrysocolla, cinnabar, clay, copper, cuprite, diatomaceous earth, hematite, labradorite, magnesite, magnetite, natrolite, niter, olivine, orthoclase, stilbite, tourmaline, vesuvianite.

Mono County.—Andalusite, anglesite, anhydrite, ankerite, argentite, arsenopyrite, aurichalcite, azurite, barite, bismite, bismuthinite, bismutite, bornite, calcite, celestite, cerargyrite, cerussite, chalcedony, chalcopyrite, chrysocolla, cinnabar, clay, cobaltite, copper, cuprite, diatomaceous earth, embolite, epidote, fluorite, galena, geocronite, gold, greenockite, gypsum, halloysite, hematite, hornblende, kalinite, lazulite, magnetite, malachite, melaconite, melanterite, molybdenite, molybdite, orthoclase, partzite, proustite, pyrargyrite, pyrolusite, pyrrhotite, quartz, rutile, siderite, silver, sphalerite, stephanite, stetefeldtite, stibnite, tetrahedrite, tourmaline, travertine, tridymite.

Monterey County.—Actinolite, arsenite, arsenopyrite, barite, bitumen, calcite, chalcedony, chromite, cinnabar, coal, copper, crocidolite, diatomaceous earth, galena, garnet, glaucophane, graphite, gypsum, iddingsite, magnesite, magnetite, malachite, metacinnabarite, molybdenite, orthoclase, pisanite, psilomelane, pyrope, quartz, serpentine, stibnite, zaratite.

Napa County.—Asbestos, azurite, barite, botryogen, calcite, calomel, chalcedony, chalcocite, chrysotile, cinnabar, copiapite, copper, coquimbite, covellite, credneriite, cuprite, diatomaceous earth, epsomite, erythrite, glaucophane, gypsum, hematite, hydrogiobertite, jamesonite, jasper, kalinite, knoxvillite, limonite, lithomarge, magnesite, magnetite, marcasite, melanterite, mendozite, mercury, metacinnabarite, millerite, mirabilite, molybdenite, morenosite, napalite, psilomelane, pyrolusite, redingtonite, rock crystal, serpentine, smaltite, stibnite, sulphur, talc, tremolite, wernerite, wollastonite, wood opal.

Nevada County.—Agate, albite, altaite, alumogen, andalusite, anorthite, anorthoclase, argentite, arsenopyrite, asbestos, axinite, barite, biotite, bismuth, calcite, chabazite, chalcanthite, chalcedony, chalcocite, chalcopyrite, chromite, chrysocolla, cinnabar, clay, cobaltite, copper, cuprite, danaite, diallage, diamond, dolomite, enstatite, epidote, galena, garnet, gold, gold amalgam, gypsum, hematite, hessite, hornblende, ilmenite, jasper, kämmererite, labradorite, limonite, magnesite, magnetite, marcasite, mariposite, melaconite, microcline, molybdenite, molybdite, olivine, orthoclase, picrolite, platinum, psilomelane, pyrargyrite, pyrite, pyrolusite, pyrrhotite, rhodochrome, rock crystal, scheelite, sericite, serpentine, smaltite, sphalerite, stephanite, stibnite, talc, tetradymite, tetrahedrite, tourmaline, uralite, uvarovite, wernerite, wollastonite, wood opal, zircon.

Orange County.—Arcanite, anhydrite, barite, calcite, cinnabar, diatomaceous earth, dolomite, fuchsite, galena, garnet, gypsum, hematite, ilmenite, magnetite, mercury, metacinnabarite, petroleum, quartz, sphalerite, tiemannite, tourmaline.

Placer County.—Andradite, anthophyllite, apatite, aragonite, arsenopyrite, asbestos, augite, azurite, barite, calcite, cassiterite, cerargyrite, chalcedony, chalcocite, chalcopyrite, chromite, chloropal, clay, clinochlore, coal, cobaltite, copper, cuprite, electrum, epidote, galena, garnet, gold, hematite, ilmenite, kalinite, kämmererite, kotschubeite, limonite, magnesite, magnetite, malachite, manganite,

marble, mariposite, massicot, millerite, molybdenite, monazite, platinum minerals, psilomelane, pyrite, pyrolusite, pyrrhotite, rhodochrosite, rhodochrome, rhodonite, rock crystal, rutile, serpentine, silver, sphalerite, stibnite, talc, tetrahedrite, tourmaline, tremolite, wood opal, zircon.

Plumas County.—Actinolite, albite, analcite, andesine, apatite, apophyllite, arsenopyrite, asbestos, azurite, bornite, braunite, brochantite, bronzite, calcite, cassiterite, chabazite, chalcocite, chalcopyrite, chromite, chrysocolla, copper, corundum, covellite, crocidolite, cuprite, diallage, dolomite, edenite, enargite, enstatite, epidote, galena, garnet, gold, hausmannite, hematite, heulandite, hornblende, hypersthene, ilmenite, jasper, labradorite, laumontite, leucoxene, limonite, magnetite, malachite, manganite, millerite, molybdenite, monazite, natrolite, oligoclase, olivine, phillipsite, platinum minerals, prehnite, psilomelane, pyrolusite, pyrophyllite, pyrrhotite, quartz, rhodonite, sericite, serpentine, siderite, silver, sphalerite, stilbite, strontianite, tetrahedrite, thomsonite, titanite, tourmaline, tremolite, wood opal, wulfenite, zircon, zoisite.

Riverside County.—Actinolite, allanite, andalusite, anglesite, anthophyllite, apatite, apophyllite, aragonite, arsenopyrite, asbestos, augite, axinite, azurite, bauxite, beryl, biotite, bismuthinite, borax, bornite, brucite, calcite, cassiterite, cerussite, chalcocite, chalcopyrite, chondrodite, chrysocolla, clay, clinochlore, colemanite, copiapite, copper, corundophyllite, crestmoreite, crocoite, cuprite, datolite, diopside, dolomite, dumortierite, epidote, essonite, galenite, garnet, gehlenite, goethite, graphite, greenockite, gypsum, halite, hematite, hyalite, hydromagnesite, jurupaite, kunzite, laumontite, lepidolite, limonite, magnesite, magnetite, malachite, manganite, merwinite, monticellite, muscovite, niter, okenite, olivine, orthoclase, periclase, plazolite, prehnite, prochlorite, psilomelane, pyrite, pyrolusite, pyromorphite, riversideite, rhodonite, saussurite, serpentine, sphalerite, spinel, spurrite, stibnite, stromeyerite, talc, tetrahedrite, thaumasite, titanite, tremolite, tourmaline, vonsenite, vesuvianite, wernerite, wilkeite, wollastonite, wulfenite, xanthophyllite.

Sacramento County.—Chromite, galena, hornblende, limonite, magnetite, rock crystal, sphalerite, talc, vesuvianite, zircon.

San Benito County.—Acmite, actinolite, aegirite, albite, aragonite, azurite, barite, benitoite, calcite, chalcedony, chalcocite, chalcopyrite, chromite, chrysocolla, cinnabar, coal, crossite, dolomite, epidote, epsomite, fluorite, garnet, glaucophane, gypsum, hematite, hydromagnesite, jarosite, kämmererite, magnesite, magnetite, malachite, mercury, metacinnabarite, natrolite, neptunite, penninite, psilomelane, rhodochrome, rock crystal, serpentine, stibiconite, stibnite, talc, tourmaline, uvarovite, valentinite, zaratite, zircon.

San Bernardino County.—Albite, anglesite, anhydrite, anthophyllite, apatite, aphthitalite, aragonite, argentite, arsenolite, asbeferrite, asbestos, asbolite, augite, autunite, azurite, bakerite, barite, bernardinite, beryl, bismuthinite, bismutite, borax, bornite, brochantite, calamine, calcite, cassiterite, celestite, cerargyrite, cerussite, chalcedony, chalcocite, chalcopyrite, chlormagnesite, chrysocolla, cinnabar, clay, colemanite, cookeite, corundum, cummingtonite, cuprite, cuprodescloizite, darapskite, dolomite, embolite, enstatite, epidote, fluorite, galena, gaylussite, glauberite, graphite, gypsite, halite, halloysite, hanksite, heliotrope, hematite, howlite, hübnerite, hyalite, hydroboracite, ilmenite, kalinite, lapis lazuli, laumontite, lepidolite, litharge, magnesite, magnetite, malachite, marble, massicot, mendozite, meteorite, miargyrite, mimetite, mirabilite, montmorillonite, moss agate, muscovite, myrickite, niter, nitrocalcite, nitroglauberite, northupite, noseam, olivine, opal, orthoclase, piedmontite, pirssonite, priceite, proustite, psilomelane, pyrolusite, quartz, realgar, rhodochrosite, sal ammoniac, sassolite, scheelite, searlesite, sillimanite, silver, smithsonite, soda niter, sphalerite, spinel, stibnite, stromeyerite, strontianite, sulphohalite, sulphur, talc, tetrahedrite, thenardite, thermonatrite, torbernite, tourmaline, tremolite, triplite, trona, turquois, tychite, ulexite, valentinite, vanadinite, voltzite, wolframite, wulfenite, zinc.

San Diego County.—Agalmatolite, albite, almandite, amblygonite, anhydrite, anorthite, apatite, arsenopyrite, asbestos, axinite, barite, beryl, biotite, bismite, bismuth, bismutite, bismutosphaerite, calcite, cassiterite, chalcocite, chalcopyrite, columbite, corundum, cyanite, diatomaceous earth, dumortierite, epidote, essonite,

erythrite, fluorite, galena, garnet, graphite, gypsite, halloysite, heulandite, hematite, hiddenite, hornblende, hyalite, hypersthene, hureaulite, kunzite, laumontite, lazulite, lepidolite, lithiophilite, malachite, mariposite, microcline, microlite, molybdenite, montmorillonite, muscovite, niccolite, olivine, orthoclase, palaite, piedmontite, polydymite, prehnite, psilomelane, pucherite, purpurite, pyrochlore, pyrophyllite, pyrrhotite, rock crystal, rock soap, rose quartz, rutile, salmonsite, scheelite, scorodite, sicklerite, sillimanite, smaltite, sphalerite, spinel, spodumene, stewartite, stibiotantalite, stibnite, stilbite, strengite, talc, titanite, tourmaline, topaz, triphylite, vesuvianite, wollastonite, zircon.

San Francisco County.—Actinolite, apatite, apophyllite, aragonite, barite, brucite, calcite, cinnabar, datolite, diallage, diopside, enstatite, glaucophane, gypsum, gyrolite, hydrodolomite, hydromagnesite, hypersthene, ilmenite, jasper, kinradite, lignite, magnesite, magnetite, mercury, olivine, opal, pectolite, pyrolusite, serpentine, titanite.

San Joaquin County.—Bementite, diatomaceous earth, gypsum, hematite, inesite, manganite, psilomelane, pyrolusite, rhodochrosite.

San Luis Obispo County.—Allophane, almogen, asphalt, bitumen, calcite, chalcopyrite, chromite, cinnabar, copper, cubanite, diatomaceous earth, dolomite, enstatite, epidote, glaucophane, gypsum, halite, hematite, hydromagnesite, ilmenite, lawsonite, limonite, magnesite, magnetite, malachite, manganite, marble, metacinnabarite, mirabilite, onyx, platinum sands, prehnite, pyrolusite, pyrophyllite, quartz, spinel, stibnite, thenardite, tourmaline, wulfenite, zircon.

San Mateo County.—Agate, barite, calcite, calomel, celadonite, chalcedony, chromite, cinnabar, diallage, diatomaceous earth, eglestonite, jasper, magnetite, margarite, mercury, olivine, pyrolusite, zircon.

Santa Barbara County.—Agate, allanite, analcite, asphalt, augite, barite, calcite, chalcedony, chalcodite, chalcopyrite, chromite, cinnabar, dolomite, eakleite, fluorite, garnet, gilsonite, gypsum, hornblende, ilmenite, labradorite, magnesite, magnetite, petroleum, platinum minerals, prehnite, rock soap, sal ammoniac, stibnite, stilbite, serpentine, vivianite, wollastonite, zircon.

Santa Clara County.—Actinolite, apophyllite, aragotite, augite, barite, bornite, calcite, caranthine, cataphorite, chromite, chrysocolla, cinnabar, clinozoisite, crocidolite, deweylite, diallage, dolomite, epidote, epsomite, ganophyllite, garnet, glaucophane, gypsum, gyrolite, hausmannite, lawsonite, limonite, lotrite, magnesite, magnetite, manganite, margarite, mercury, metacinnabarite, oligoclase, omphacite, paragonite, paragasite, petroleum, picrolite, pilinite, psilomelane, pyrite, pyrochroite, pyrolusite, rhodochrosite, rhodonite, rutile, serpentine, siderite, smaragdite, soretite, sphalerite, stibiconite, stibioferrite, stibnite, talc, tephroite, tiemannite, titanite, tremolite, zoisite.

Santa Cruz County.—Bitumen, calcite, coal, graphite, gypsum, ilmenite, magnetite, melanterite, olivine, petroleum, platinum sands, talc, tremolite, vesuvianite, zircon.

Shasta County.—Andesine, anhydrite, asbestos, barite, bornite, calcite, chabazite, chalcanthite, chalcocite, chalcopyrite, chromite, cinnabar, copper, covellite, cuprite, deweylite, diatomaceous earth, epidote, galena, garnet, gold, greenockite, gypsum, halite, hedenbergite, hematite, hessite, ilmenite, ilvaite, kämmererite, limonite, magnesite, melanconite, melanterite, mesolite, molybdenite, molybdite, natrolite, orthoclase, platinum minerals, proustite, psilomelane, pyrargyrite, pyrite, pyrolusite, pyrrhotite, siderite, silver, sphalerite, spinel, stephanite, talc, tellurium, tetrahedrite, tremolite, tridymite, witherite, zaratite, zinc, zircon, zoisite.

Sierra County.—Arsenopyrite, asbestos, chalcocite, chalcopyrite, chromite, chrysotile, covellite, galena, gold, hessite, magnetite, mariposite, natrolite, platinum minerals, pyrolusite, pyrrhotite, quartz, serpentine, sphalerite, stibnite, stromeyerite, talc, wood opal.

Siskiyou County.—Asbestos, azurite, barite, calaverite, californite, cassiterite, chalcocite, chalcopyrite, chromite, chrysocolla, chrysotile, cinnabar, clinochlore, copper, covellite, deweylite, diamond, epidote, galena, garnet, gold, graphite, gypsum, hematite, hypersthene, ilmenite, limonite, jasper, marble, molybdenite,

olivine, opal, ottrelite, petzite, platinum, platiniridium, psilomelane, pyrite, pyrolusite, pyrrhotite, rhodonite, scheelite, sphalerite, spinel, talc, tin, tourmaline, uvarovite, vesuvianite, wolframite, wollastonite, zaratite, zircon.

Solano County.—Aragonite, calcite, cinnabar, chromite, clay, halite, metacinnabarite, onyx marble, sulphur.

Sonoma County.—Actinolite, almandite, aragonite, azurite, boussingaultite, bronzite, calcite, chalcopyrite, chromite, chrysotile, cinnabar, clay, coal, diatomaceous earth, epidote, epsomite, garnet, geyserite, glaucophane, grahamite, graphite, grossularite, gypsum, hematite, ilvaite, jasper, kalinite, limonite, magnesite, manganite, marcasite, margarite, mascagnite, melanterite, mercury, metacinnabarite, natrolite, psilomelane, pyrite, pyrolusite, realgar, serpentine, siderite, smaragdite, sonomaite, stibnite, stratopeite, sulphur, talc, wood opal, zircon, zoisite.

Stanislaus County.—Actinolite, asbestos, bementite, cinnabar, clay, enstatite, epidote, glaucophane, gypsum, hematite, inesite, limonite, magnesite, psilomelane, pyrolusite, quartz, rhodochrosite.

Sutter County.—Clay, coal.

Tehama County.—Arsenopyrite, chalcopyrite, chromite, copper, cristobalite, diatomaceous earth, galena, garnet, graphite, magnetite, pectolite, platinum minerals, psilomelane, pyrolusite, siderite, sulphur, talc, wollastonite.

Trinity County.—Andradite, arsenopyrite, asbestos, azurite, barite, bieberite, bornite, calcite, cassiterite, chalcocite, chalcopyrite, chromite, cinnabar, claudetite, cuprite, diamond, enstatite, epidote, fibroferrite, galena, garnet, glaucophane, gold, goslarite, gypsum, hematite, hessite, hornblende, ilmenite, jasper, magnetite, malachite, mercury, meteorite, molybdenite, olivine, orpiment, platinum minerals, pyrite, pyrrhotite, realgar, römerite, serpentine, sphalerite, stibnite, sulphur, sylvanite, talc, titanite, tourmaline, wollastonite, zircon.

Tulare County.—Agate, alexandrolite, allanite, annabergite, arsenopyrite, asbestos, asbolite, calcite, californite, chalcopyrite, chromite, chrysopal, chrysoprase, copper, cuprite, diatomaceous earth, epidote, galena, garnet, graphite, gypsum, ilmenite, jefferisite, limonite, magnesite, magnetite, malacolite, minium, molybdenite, nepheline, opal, orthoclase, perthite, pyromorphite, quartz, rhodonite, rock crystal, rose quartz, satelite, scheelite, soda niter, sphalerite, stibnite, stilbite, sulphur, talc, tourmaline, tremolite, wollastonite, wood opal.

Tuolumne County.—Albite, altaite, ankerite, aragonite, arsenopyrite, asbestos, azurite, berthierite, beryl, calcite, chalcanthite, chalcocite, chalcopyrite, chromite, cinnabar, coloradoite, coquimbite, cristobalite, cuprite, cyanite, diallage, dolomite, dumortierite, enstatite, epidote, erythrite, galena, garnet, gold, graphite, gypsum, hematite, hessite, ilmenite, jasper, kalinite, magnetite, malachite, manganite, marble, mariposite, molybdenite, molybdite, orthoclase, petzite, psilomelane, pyrite, pyrolusite, pyrrhotite, quartz, rhodonite, scheelite, serpentine, sphalerite, sylvanite, talc, tellurium, tetradymite, tetrahedrite, tin, tourmaline, tremolite, tridymite, wollastonite, wood opal.

Ventura County.—Boussingaultite, colemanite, galena, gypsum, halloysite, hydroboracite, lenzinite, mesolite, millerite, molybdenite, muscovite, petroleum, platinum sands, priceite, sulphur.

Yolo County.—Asbestos, cinnabar, limonite, metacinnabarite.

Yuba County.—Bauxite, calcite, chalcopyrite, chromite, enstatite, epidote, gold, hematite, ilmenite, magnetite, monazite, molybdenite, olivine, pilolite, platinum sands, rutile, serpentine, sylvanite, talc, tremolite, vivianite, zircon.

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